ELECTRICAL REVIEW

ILLUSTRATED.

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Electric Light, Power, Telephone, Telegraph and Scientific Progress.

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VIEWS, NEWS AND INTERVIEWS.

"What's new?" was asked of a prominent man in the electrical field.

"Nothing is new in electricity," he answered, "unless it is 48 hours ahead of time."

Most of the large stores in New York are kept open till 10 o'clock at night for several weeks preceding Christmas. This means money to the electric light companies. One furniture store on Fourteenth street uses 36 arc lights on the outside of the building. A Sixth avenue store has a tower on each corner. In the towers arc lights with red shades have been placed. This and many other effects are very striking.

"I have lots of fun in a quiet way," said an ex-telegraph operator who has acquired wealth. "I was dining at the Murray Hill Hotel the other night and while waiting to be served, I began to tick on a plate with my knife. In a few minutes I got an answer in the same way from the other side of the room. Conversation was maintained for some time and finally names were exchanged. I stood up and, looking across the room, saw an old side partner of mine whom I had not met for years. We dined together and spent a pleasant hour talking over old times."

Among the recent callers at Mr. Cleveland's cottage at Lakewood, N. J., were Electrical Commissioner Jacob Hess and Dr. J. B. De Lery, the owner of South Lakewood Park, the Electric City.

E. D. Fulford is undoubtedly the world's greatest pigeon shot. In the first of three matches at 100 live birds, for $200 a side on each match, Fulford recently defeated the famous shot, Capt. J. L. Brewer, on the grounds of the Jersey City Heights Gun Club, at Marion, N. J., by a score of 100 to 99. Fulford is a resident of Bridgeport, Conn., and is 29 years of age. For some time he has been superintendent of construction for a telephone and telegraph company at Harrisburgh, Pa.

An amusing incident of a recent match of Fulford's is this: He telegraphed to a crony out in Ohio as follows:

"Won the championship.

E. D. FULFORD."

When the dispatch was received it read:

"Were the champions shipped?

E. D. FULFORD."

A strange death is reported from New Orleans. It is said that while playing a hose upon a fire a telephone wire and an electric light wire got crossed, the stream of water from the nozzle struck the wires, a heavy current followed down the water and killed the fireman who was holding the nozzle.

A well known New York banker who is interested in electrical enterprises has made some figures by which he shows that the volume of business transacted in New York, is $3,000,000 in amount for the year past than for the preceding year. The volume of business in the West increased during the year, though not to the same extent.

"I explain this partly," said the banker, "by the fact that in the East a large bulk of the wealth is held by a few men. Conservatism on the part of these few clogs the wheels of commerce. In the West wealth is more evenly distributed and conservatism on the part of a few is not so immediate or effective in its results."

Edgar Fawcett, the novelist, has written a new book called "A Romance of Two Brothers." A life elixir consisting of liquefied electricity is responsible for many of the dramatic incidents of the story. The receipt for making liquefied electricity, is unfortunately, shrouded in mystery.

An American Inventor Returns from Europe.

Mr. Charles S. Bradley, electrical engineer and inventor, of Fort Wayne, Ind., has just returned from a two months' business trip to Europe.

"I missed the Frankfort Exhibition," said Mr. Bradley, "but I was present at the long distance transmission test. I think the report of the commission on this experiment will probably be published in February.

"I visited one of the city electric light plants in Berlin. The construction is much more solid and expensive there than it is in America. In spite of the great cost of these plants, I am told that they pay quite respectable dividends. The arc light fixtures in Berlin are especially handsome—far superior to anything we have here. As for electric railways, there are practically none.

"I saw the Thomson-Houston road which has recently been started in England. It seems to run successfully.

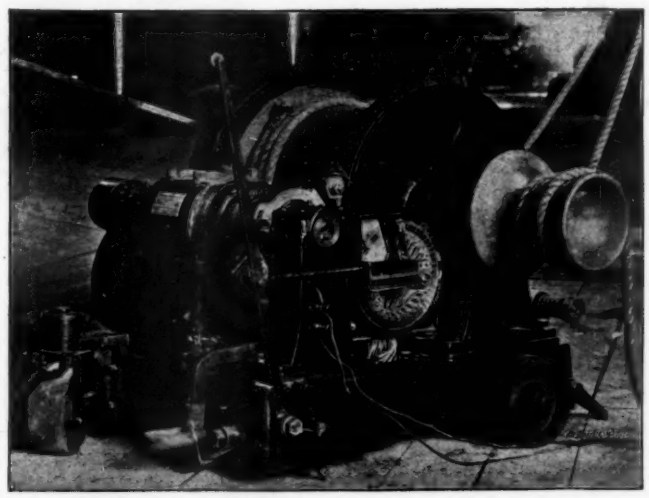
"Electrical matters in Europe seem to be passing through a period of commercial development. I saw nothing startlingly new. It would not be polite to say that Europeans are behind us in electrical matters, but I guess it is so.

"I was impressed with one fact during my trip, which was very hurried, and that was that foreigners cannot seem to appreciate the American way of doing business. If I succeeded in making one business engagement a day I considered myself lucky."

A Large Electric Hoist Plant.

What is probably the largest electric hoist plant in the country is that recently installed by the Thomson-Houston Electric Company on the docks of the Wilson Steamship Company, Brooklyn, N. Y. The Wilson line has three docks, and each dock is equipped with three hoists. Our illustration shows one of the hoists. As will be seen, the cover of the rheostat is removed.

Each hoist is rated at 10 horse-power and designed to carry 1,400 pounds. At a recent test of the plant it was arranged that at a given signal, by whistle, six of the nine hoists were started at the same instant, each hoist carrying a load of 1,500 pounds, consisting of three 500 pound bales of merchandise. This load was raised at a good speed and without in any way straining the plant. In order to test the capacity of a single hoist, the load was started at 1,500 pounds and 500 pound bales were added until six, of a total weight of 3,000 pounds, were raised by a single 10 horse-power hoist This, of course, was more than double the rated capacity, but the hoist handled the load very easily. During the test the hoist, not being securely fastened to the dock, was lifted bodily from its place when the heaviest load was put on, but after being secured, the load was raised with apparent ease. The hoists are easily controlled, either raising or lowering the load, and the Wilson Company express themselves as being entirely satisfied with the plant.



THOMSON-HOUSTON ELECTRIC HOIST ON DOCK OF WILSON STEAMSHIP COMPANY, BROOKLYN, N. Y.

Current is furnished to the hoists from a plant established on one of the piers. There is a 50,000 watt, 500 volt, 100 ampere Thomson-Houston generator of the motor type. The speed of the armature is 1,020 revolutions per minute. Current is led from this machine by three circuits to slate fuse blocks placed near the hatch openings on the docks. Grimshaw flexible cables are carried from the hoists to the fuse blocks. There is also a 30 light Thomson-Houston arc dynamo, which supplies lights for handling freight at night. A 70 horse-power 11x12 McIntosh & Seymour engine drives the dynamos. Steam is furnished from an 80 horse-power Porter locomotive type boiler. Schieren's perforated electric leather belting is used.

A new type of hoist is being made by the Thomson-Houston Company. It will have a new clutch lever and direct gears run in oil. This will tend to do away with a large proportion of wear, tear and noise. Arrangement will also be made to fasten the hoist to the dock with permanent eye-bolts at each hatch opening.

This plant was sold and installed under the direction of Curtis & Deane, 115 Broadway, New York agents for the Thomson-Houston Electric Company.

Mr. Wanamaker's View of Electric Railways.

Postmaster-General Wanamaker's appreciation of the value of electrical rapid transit in the postal service is shown by the following extract from his recent report to Congress:

"A new element in transportation is likely to furnish the means of advancing mails in rural neighborhoods adjacent to cities and large towns. I refer to the electric railway systems. They are going into suburbs not traversed by horse cars: and where other means of conveyance must be slow, because of the rolling character of the country, they travel uniformly eight or ten miles per hour, and with a frequency much greater than would be required even with free delivery exten ions.

"Some months ago it was possible to arrange with the electric line operating between St. Paul and Minneapolis, whereby boxes were attached to each car so that mail matter can be deposited from the outside. At the ends of the route this mail is turned over to the local offices for immediate distribution and delivery. The result has been the accomplishment of the same extent of free delivery of St. Paul and *en route* mail at Minneapolis as within its local jurisdiction, and *vice versa*.

"The next step should be in the direction of, say, a half dozen intermediate stations upon which pouching could be made with the terminal offices. It is true this system will not ramify in sparsely settled regions, but it can be utilized vastly to improve the service between towns lying within close distances, and among rural neighborhoods. I mention Wheeling, W. Va., for example, as the base, and associate it with Benwood, W. Va., and Bellaire, Martin Ferry and Bridgeport, Ohio. These are thriving manufacturing places, each independent of the other, but really having all the relations of one municipality; and the electric system will permit of a frequency of mail interchanges nearly as desirable as that attending free delivery itself. A similar case is receiving attention on the Mississippi River between Davenport, Iowa, and Rock Island, Milan and Moline, Ill. I believe opportunities of the same kind will become more and more frequent."

New York State Appropriation for the World's Fair.

The dry goods merchants of New York city have drawn up a bill to present to the legislature and a letter to Governor-elect Flower in which they ask for a sufficient appropriation, $500,000, or part of it, to enable the State to be properly represented at the World's Fair. The committee is composed of members of the following firms: William L. Strong, of William L. Strong & Co., and president of the Central National Bank, chairman; John Claflin, president of The H. B. Claflin Company; John Gibb, of Mills & Gibb; W. E. Tefft, of Tefft, Weller & Company; J. Howard Sweetser, of Sweetser, Pembrook & Company; William F. King, of Calhoun, Robbins & Company, secretary of committee.

Electrical Needs of the Government.

APPROPRIATIONS FOR NEXT YEAR.

Four hundred and nine million dollars is the amount required to pay the running expenses of the United States government for the year commencing on the first of July, 1892. A very considerable proportion of this sum will be expended for electrical appliances and services, and the profit and glory supposed to go with government contracts will induce strong competition among bidders.

The Navy Department will be the largest customer of electric companies and a good share of the $1,000,000 estimated for the bureau of equipment will be needed to carry out the plans of Commander Newells' office for electric plants to be installed on the war ships now under construction. The bureau of yards and docks submits an estimate of $32,000 for a lighting plant at the League Island Navy Yard, and recommends the lighting of the other yards at the rate of one each year. The Naval Academy also wants electric lights and asks for an appropriation of $800 for the salary of an electrician. The ordnance bureau needs a telegraph line from the Washington Yard to the ordnance proving ground at Indian Head, on the Potomac river, at a cost of $5,000. The naval station at Port Royal, S. C., also wants a telegraph and telephone line which will cost $1,500.

The Army Signal Office, now that it has been relieved from the exasperating duty of managing the weather and the still more exasperating duty of fighting the Western Union Telegraph Company over the tariffs on weather reports, is giving more attention to its regular business of field telegraphy. It is making plans for the organization of a system of army telegraphs and asks for an appropriation of $25,000 to carry on its experiments. An additional sum of $1,000 is wanted for experimental work in connection with the development of a portable electric apparatus suitable for both night signaling and search-lights.

The National Soldiers' Home, at Santa Monica, Cal., wishes to be illuminated by electricity and says a complete plant can be had for $25,000. The Home at Dayton, Ohio, evidently needs a visit from some enterprising electric light man, inasmuch as it asks for $16,040 to replace an old worn-out gas-holder.

The West Point Military Academy also appears to be somewhat old-fashioned in asking for $900 to buy a water motor, with a view of rendering the "general effect of the chapel organ exceedingly full and majestic."

The Superintendent of the State, War and Navy Building makes the peculiar request for $2,880 to pay "four *firemen* to operate the electric light plant." The explanation is, that in an establishment so full of titled dignitaries, it would not do to call a man who simply operates an electric plant on a small salary an "engineer."

The Interior Department has no scruples on this subject, and boldly asks for $1,200 for an electric light engineer and $900 for a wiring expert.

The Commissioner of Patents would like to have $125,000 to pay the salaries of additional examiners and clerks, and repeats the ancient and pathetic statement that "the present force of examiners is inadequate for the proper consideration of matters coming before them. The increase in the number of applications for patents necessitates an increase in the examining corps in order to insure a prompt dispatch of business coming before it. The inventors pay into the treasury more than sufficient to provide the needed force and facilities, and they expect a speedy determination of their applications for patents. Without an increase in the force vexatious delays must ensue."

The Postmaster-General states that the gas lights in his department are dim and unsatisfactory, and that $3,000 can be well expended in wiring and equipping the building for electric lights.

The Treasury Department wants $1,900 for the salary of Superintendent Powell, and $50,000 for wiring public buildings under his supervision. There is also an item of $775,000 for miscellaneous expenditures out of which Powell will get all he can to repair existing plants and install new ones in the post offices and custom houses throughout the country.

The White House is lighted from the War Department plant, and only $1,000 is needed for the care and maintenance of the lamps and wires. The main wires leading to the White House go feebly climbing along the conservatory wall, but the administration has more economy than pride and so the conductors are not laid underground. Two thousand dollars is estimated as the cost of erecting eight iron lamp-posts in the Monument grounds, connecting them with underground wires and supplying electric lights for them. This work is under the control of the Commissioner of Public Buildings and Grounds. That officer also has charge of the telegraph lines connecting the Capitol and departments, which are in such a dilapidated condition that they need rebuilding. The estimate is for $31,000 for an underground system, or $1,600 for new poles. The government will probably adopt the latter recommendation—and continue its warfare on overhead lines belonging to private companies.

The Capitol Building rests in darkness. The designers of the structure commenced by shutting all the daylight out of the halls in which the Senate and House meet. For the last ten or fifteen years "Pop" Talcott, the veteran electrician, has regularly turned on a current of electricity to light the gas jets placed up in the garret, which are dimly discernable through the semi-transparent sky-lights, while the legislators have been wrestling with delusive problems concerning current-strength, candle-powers, etc. The architect of the Capitol, Mr. Edward Clark, has recommended the establishment of an independent station outside the grounds, to furnish light for the entire building, but, so far, no appropriation for that purpose has been made. The Westinghouse plant in the Senate and the United States plant in the House, which were installed by the respective companies several years ago, at their own expense, are still running, and the government pays a rental of $200 per month for their use. These do not meet the demand for lights, and the architect reports that additional dynamos will be needed, provided his station plan is not carried out.

The Government Hospital for the Insane renews its request of last year for $22,500 for an electric plant for incandescent lights and ventilating fans.

For the purchase of one engine, two dynamos, and complement of arc and incandescent lamps, including all expenses of installation, the National Museum estimates the moderate sum of $5,000.

The appropriaiton asked for the District Police and Fire Alarm Telegraph and Telephone service is $33,020, an increase over last year's appropriation of $14,000.

The government continues to be a good customer of the local electric lighting company, and makes provision to pay it $70,000 next year for 1,000 candle-power lamps, burning every night from sunset to sunrise, at 50 cents per night, with the express stipulation that every light shall be operated on underground wires. The company has a three year contract at this rate. G. C. M.

Washington, Dec., 21, 1891.

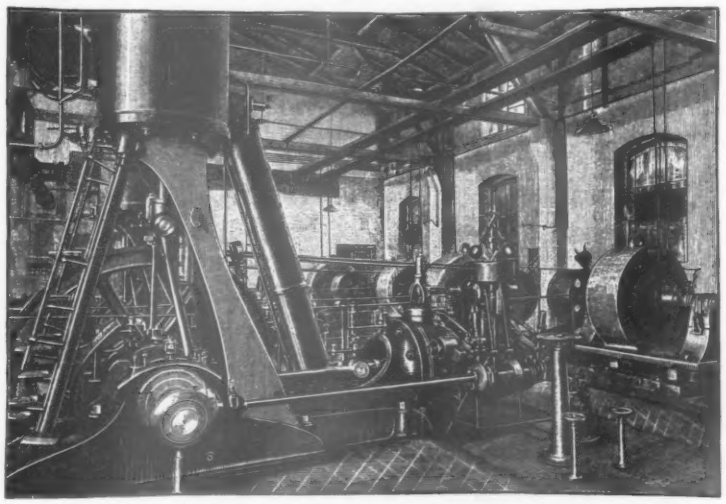


FIG. 1.—INTERIOR OF ELECTRIC RAILWAY POWER HOUSE, AT HALLE, GERMANY.

To Advertisers.

"Writing or printing is like shooting at a mark with a rifle, you may reach the reader's mind or miss it; but talking is like playing at a mark with the pipe of a fire engine—you can't help hitting it," therefore, write your advertisements as you might talk. Talk to please customers, anticipate their objections and speak of your wares as though face to face, instead of through printers' ink.—*Inland Printer*.

The Washington Carbon Company.

This very vigorous company, which is located at Washington, Pa., is making quite a pronounced stir in electric lighting circles by reason of its announcements in relation to the so-called "Carbon Trust." The Washington people claim that this trust now includes all the other carbon manufacturers, and they alone are in a position to supply carbons to electric lighting companies independent of dictation.

The electric light man will not be found grumbling over anything that will reduce the price of carbon pencils, a very material element of his expense, and the Washington Company is already said to be reaping a rich harvest as a result of the emphatic and conspicuously independent way its business ideas and methods are being announced.

A New, Short, Useful Cable.

Within the next three days, according to despatches from London, a steamship carrying a submarine cable of some interest to us will leave the Thames for the West Indies, says the New York *Sun*. This cable is to be laid between British territory and American territory, or between the important port of Nassau, on the island of New Providence, and Fort Jupiter, on the coast of Florida. The laying of the cable is to be begun at its Florida end, from which it will run for a distance of 230 miles to its West Indian end. In Florida it will be connected with the wires of the Western Union, so that the whole of the United States will be put in direct telegraphic communication with New Providence, and we shall have another line between this country and the West Indies. Sir Ambrose Shea, the governor-general of the Bahamas, who left this city yesterday for Nassau, after spending a few weeks here, says that the new cable will be in operation within a month from this time.

The new cable line between Florida and the chief port of the Bahamas will be serviceable in the promotion of trade, as are the other lines between this country and other islands of the West Indies.

The Electric Street Railway at Halle, Germany.

The electric street railway at Halle (Saale) is about the only example in Europe of a street railway system as employed in America, the railway from Frankfort to Offenback using slit tubes for overhead conductors and the road at Budapest the underground conduit, both of which systems are very different from those used in America.

Although the system used in Budapest is in daily operation, and from all reports working with entire satisfaction and economy, still, although that road has been in operation for some time, there seems to be no inclination on the part of other cities in Germany and Austria to adopt that system; but Dr. Northman, electrical engineer for Siemens & Halske, Berlin, states that this system will soon be introduced on a large scale on one of the street railways in America by that company.

The railway at Halle was built by the Algemeine Electricitäts Gesellschaft, of Berlin, and the system and motors used are of Sprague and Edison type. This road began operation in the Fall of 1889, and there are now about 21 cars running daily on the different lines. Each car is equipped with two motors of 12 to 15 horse-power, operated at 500 volts, and the armatures and axles are connected by double reduction gear. The cars and overhead trolley construction may be seen in Fig. 2, which shows the stopping places in Marktplatze and Riebeck Platze, in Halle.

The dynamo and engine room (Fig. 1), although designed for three engines and six dynamos, at present only operates two engines and four dynamos.

The engines are of peculiar construction, having one cylinder with piston, piston rod, etc., working horizontally and are arranged vertically. There are two engines of this type of 200 horse-power each. They are compound engines, working at a pressure of 10 atmospheres and at a speed of 180 revolutions per minute. The high pressure cylinder is the horizontal cylinder, and has a diameter of 340 millimetres with a stroke of 550 millimetres. The low pressure vertical cylinder has a diameter of 510 millimetres and a stroke of 550 millimetres, with a working pressure of two atmospheres. The exhaust of high pressure cylinder is delivered to the receiver extending from the vertical low pressure to the horizontal high pressure cylinders. These engines were furnished by the Actien-Gesellschaft Gorlitzer Maschmen-bau Austalt, in Gorlitz. The regulator is of the Collmann type.

The dynamos are of the four-pole type, built by the Algemeine Electricitäts Gesellschaft, and are four in number, two being bolted to each engine.

The capacity of each machine is 60,000 watts (120 amperes at 500 volts). Ring armatures are used and the normal speed is 520 revolutions per minute, and they use about 90 horse-power. The feeders for the overhead wires are all placed underground, lead covered and iron armored cables being used.

There are in the boiler house three Steinmuller boilers, each having a heating surface of 151.6 square metres. Two of them are in daily use and the third is held in reserve. These boilers are worked at 10 atmospheres.

FRANK C. PERKINS.

Recovering Gold and Silver by Electricity.

A French photographic journal describes a method of recovering the gold and silver waste of photographic processes by means of electricity. The process consists of suspending in the solutions containing these metals a plate of carbon to the positive pole of the battery, and a zinc plate to the negative, the two being separated by the space of about an inch and a half. With the closing of the circuit from any ordinary battery there is formed on the zinc electrode a black deposit, which falls to the bottom of the solution. This deposit, after being removed and dried, is melted in a crucible, forming an ingot of metal.

PRACTICAL NOTES ON THE REFLECTING GALVANOMETER AND ITS ACCESSORIES.

BY J. D. BISHOP.

V.

SHIELDING THE GALVANOMETER.

Supposing the galvanometer, in spite of all the above precautions, still gives an unsteady spot, the last resource is the employment of a shield, for it is evident that the disturbance now present must be due to induced currents. In order to save the trouble of making a regular shield, it might be as well, perhaps, to try and discover the direction from which the disturbing currents arrive. This may be done in a very simple manner.

Get a piece of boiler plate one-quarter to three-eighths of an inch in thickness, and of any available size, say, nine inches by one foot. Roughly file off any ragged edges and corners there may be, and hammer it out fairly flat. It will be all the better, if you have the time, to let the engineer put it in the boiler furnace till it gets thoroughly red hot, then remove it and bank it in the ashes for a few hours, withdraw it, heap it over with cold ashes and let it remain to cool.

Take your plate and hold it vertically near the galvanometer, closely watching the spot whilst you slowly change the position of the plate. You may find that in a certain position the plate is in a direct line between the galvanometer and some moving machinery, in which case the activity of the spot will be sensibly diminished. Make a note of that position, continue the motion of the plate around the galvanometer and see if any further changes in the motion of the spot can be produced.

If there is but one or two positions in which the plate cuts off the disturbing currents, the simplest and quickest way is to stick up a large sheet of thick, soft iron boiler plate in the positions indicated by the above course; sometimes this is very effectual, but if it does not prove sufficient, the following is about the best way of making a shield.

Measure the base of your galvanometer stand diagonally from one corner to the opposite one. Suppose this be 10 inches, look about for a piece of old iron pipe of 11 inches in diameter; exactitude is of no importance, but the closer the shield is to the galvanometer the better. The length of the pipe should be an inch or two greater than the height of the galvanometer, measuring from the board to the crown plate on which is screwed the adjusting magnet. The thicker this piece of pipe the better. It should now be turned at both ends, and neatly cleaned up, either in the lathe or by means of emery cloth. Now measure the precise height from the board to the center of the mirror, and draw a line on the pipe at that distance from one of its ends at right angles to the axis of the pipe. Have a slot three inches long by one inch wide, cut in the pipe taking that line as a center, and on the other side of the pipe, diametrically opposite to the center of this slot, drill a one inch round hole. The object of the slot is, of course, to admit the light through the mirror as well as the exit of the ray reflected from it, and the object of the hole at the back is to permit inspection of the mirror from the rear end.

Now measure the height from the board to the shoulder of the galvanometer terminals, and at that distance from the edge of the pipe, and in such a position as to be opposite the terminals, and the same distance apart, bore two more holes, say, half an inch in diameter, into which insert tightly two short pieces of hard rubber tubing, of, say, three-sixteenths or a quarter inch bore, one inch long will be sufficient. These holes are to allow the galvanometer leads to be passed through. Now drill two more holes one-half inch in diameter, exactly opposite each other, about half an inch below the upper edge of the pipe. These are to receive two hooks, which are made fast to a line passing through a pulley firmly screwed into the ceiling or into a cross piece laid over the top of the wooden frame-work, and by means of which the shield may be lifted up out of the way when access to the galvanometer is required. When the shield is finished it should be thoroughly annealed and treated with two or three coats of black hard japan, so that dust may be easily removed from it. If there is no moving machinery in a line above the galvanometer this shield will be found to answer admirably, but if there should be machinery creating vertical currents, have a disk of wrought iron cut from the boiler plate half an inch in diameter larger than the outside measurement of the pipe. Remove the adjusting magnet with its stand from the top of the galvanometer, and place the disk annealed and varnished on the top of the shield. The extra half inch diameter affords facility for removing and replacing the disk when necessary. When the shield is in place on the board, you will, of course, have to remove lead weights of an equal amount, and it is well to provide two pieces of lead a pound or two in excess of the weight of the shield to place on the board before removing the shield when it becomes necessary to do so. These lead weights should be cast with slanting or grooved sides, so as to afford a good grip.

In case no iron pipe, such as above described, should be obtainable, a double wooden box made to meet the same precautions may be used. The inner box should be at least one inch or one inch and a half smaller in every direction than the outer, and the interspace filled with soft iron filings. The boxes may be made of tin or zinc and the filings should be well shaken down. But care must be taken that the boxes are both tight so that no filings can escape, or they will cause a great deal of trouble.

A shield may also be made from an old iron safe. The mass of iron in a safe is, however, very irregularly distributed, and its influence on the needles at different angles is, therefore, variable. The piece of iron pipe is in every way more reliable and economical.

During the arrangement of either of the above shields, and, in fact, always, great care must be taken to steady the board whilst removing or shifting the weights, so as to avoid jerking or swinging the galvanometer too suddenly, which might set the mirror spinning round, or at least give it a twist. The best motto with all galvanometer work is "*Festina lenta*"—"Go slow."

In placing the shield be careful to bring the center of the slot exactly opposite the center of the mirror and the hole at the back in a straight line with it, so that by looking through it, either from front or back, a clear view of the mirror is obtained.

If the spot is still unsteady, dig down to the solid rock, if possible, and build up a column of cemented brick from the rock up to the required height above ground. From the rock up to the ground surface a wooden casing should surround the column, with a space between them of three or four inches, so that the ground shall not communicate its vibrations to the column, and for the same reason the floor and joists should be cut away all round so as not to touch it. A shelf or ledge may then be run around the column itself, broader than the space between the column and the floor and two or three inches above it, to prevent things dropping into the space from the galvanometer board.

A fillet one inch high should also be placed around the hole in the floor, to prevent things from rolling into it and being lost. Attention to these details all tend to save worry and vexation.

On the top of the column, which should be an inch or two larger than the bottom of the galvanometer suspension frame, place a lead casting three to four inches thick, and on this place the frame. If the spot is still unsteady give it up and try another galvanometer, or another position, or both.

The experience of the operator may, as he proceeds, point out to him the necessity of modifications, or even radical departures from the above instructions, dependent on the circumstances of the case.

It is absolutely impossible to give even hints which meet every opposing condition, and the above suggestions are, therefore, subject to intelligently broad interpretations.

Varying with conditions and the quality of the galvanometer, the time required to get one to work well may be anywhere from 15 minutes to 15 weeks.

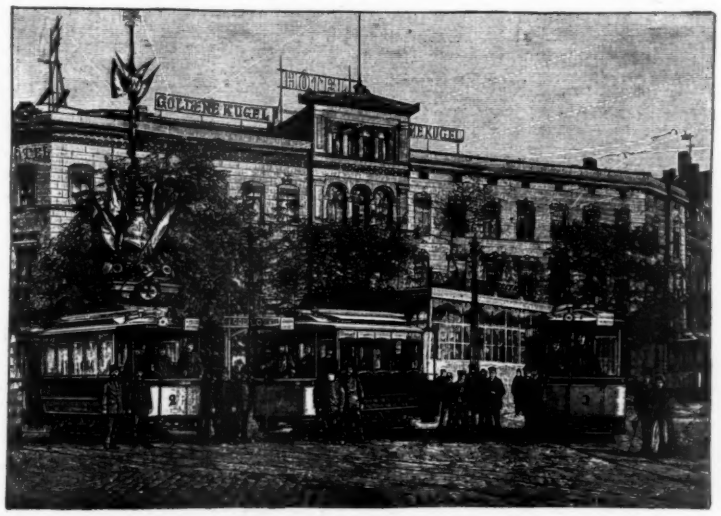


FIG. 2.—ELECTRIC CARS AT HALLE, GERMANY.

Employers' Liability.

Gustave Fiolka has sued the United States Illuminating Company, of New York. The complaint made by Fiolka is that he was working at the Washington street station last July, and was directed by Electrician Van Wagner, then in charge, to fix certain wires that were strung upon the ceiling.

He alleges that Wagner told him the wires were "dead." In making the repairs he received a severe shock, the current burning his right wrist severely. Dr. Sweeny, of Greenwich street, attended him there and Dr. Henry N. Veitch, of Fulton street, has been attending him ever since. Fiolka asserts that no rubber gloves or other non-conducting agents were furnished by the company in the discharge of his work.

The company offered Fiolka $150 as a settlement, but he refused it.

The defendants say that the damage, if any, arose through contributory negligence on the part of the plaintiff. They also deny that they failed to supply the proper and necessary implements to make the plaintiff's work safe. This is the second electric light case of this nature that has been in litigation. The first was brought by John Doorley against the same company last May. It was tried before Judge Dugro in the Superior Court, and Doorley was awarded $2,500 damages.

National Electric Light Association.

The following official communication has been received:

NEW YORK CITY, Dec. 14, 1891.

TO THE EDITOR OF ELECTRICAL REVIEW:

The fifteenth convention of this Association will be held at the Iroquois Hotel, Buffalo, N. Y., February 23, 24 and 25, 1892.

Mr. C. O. Baker, Jr., has been appointed general master of transportation, with headquarters at the office of the Association, 136 Liberty street, New York, where all communications relating to transportation should be addressed.

President Huntley directs me to advise you that he has appointed the writer secretary of the Association, to date from December 1, *vice* J. W. Beane, resigned.

Very respectfully,
GEO. F. PORTER, Sec.

President Huntley has worked with a vim for some time past on the preliminary arrangements for this meeting. He intends to make it a success if hard work on the part of the Association's officials will do it.

Mr. Porter has taken up his new work in his characteristic, energetic style. His large acquaintance among electrical people makes Mr. Porter especially valuable to the Association.

His friends will regret to learn that Mr. Beane is suffering with a severe illness.

Owatonna, Minn.—Owatonna Electric Company; capital, $25,000.

Fresno, Cal.—Fresno Electric Railway Company; capital, $1,000,000.

Chicago, Ill.—Atlas Electrical Manufacturing Company; capital, $12,000.

Ottumwa, Ia.—Ottumwa Electric Railway Company; capital, $500,000.

San Diego, Cal.—San Diego Electric Railway Company; capital, $250,000.

Hartford, Conn.—Gray Pay Station Telephone Company; capital, $100,000.

San Francisco, Cal.—Electric Railway Development Company; capital, $500,000.

East St. Louis, Ill.—Franklin-Morse Electrical and Mechanical Manufacturing Company; capital, $5,000,000.

Decatur, Ill.—City Electric Railway Company; capital, $300,000. Incorporators, D. S. Shellabarger, James Milliken, James O. McReynolds and others.

Richmond Hill, N. Y.—West Jamaica Electric Light Company; capital, $2,500. Promoters, Geo. Lestle, Wm. Kessler and O. W. Graves, of Richmond Hill.

Belleville, N. J.—The Belleville Electric Light Company; capital, $100,000. Promoters, A. F. Crawford, Haverstraw, N. Y.; E. S. Frazer, Mt. Vernon, N. Y., and H. V. Cole, Belleville, N. J.

Philipsburg, Mont.—Philipsburg Granite Electric Light Company; capital, $50,000. Promoters, George P. Durham and John R. Cox, of Philipsburg, Mont., and John M. Evans, of Missoula, Mont.

Newville, Pa.—Newville Electric Light, Heat and Power Company; capital, $5,000. Promoters, W. G. Stewart, Stacy G. Clauser and Jas. A. Woodburn. Incorporation papers sent to Robert McCachran, Newville, Pa.

Cincinnati, O.—The Card Electric Motor and Dynamo Company; capital, $100,000. Promoters, Joseph W. Wilshire, George Bullock, Otto W. Jantz, G. N. Stone, C. B. Simrall, Franklin Alter and Stephen R. Burton. Incorporation papers sent to C. B. Simrall, Cincinnati, O.

Jersey City, N. J.—The State Electric Light, Heat & Power Company; capital, $100,000. Promoters, H. V. Cole, Belleville, N. J.; Edw. S. Frazer, Mt. Vernon, N. Y., and A. F. Crawford, Haverstraw, N. Y. Incorporation papers sent to Wm. S. Baker, Jersey City, N. J.

Jersey City, N. J.—Crocker-Wheeler Electric Company; capital, $200,000. Promoters, F. M. Jeffry, 306 Pavonia avenue, Jersey City; W. H. Geers, 431 West Fourteenth street, New York; G. S. Dunn, H. H Crocker, 54 West Twenty-first street, New York; A. K. Sloan, Brooklyn.

American Electrical Works.

The usual unique holiday remembrance has come from the American Electrical Works, Providence, R. I. Messrs. Eugene F. Phillips, president; W. A. Hathaway, treasurer, and W. H. Sawyer, secretary, unite in sending a handsomely printed Christmas card to which is attached a sprig of evergreen and a little cornucopia. "We deeply regret," says the card, "that it is impossible for our many customers to be present with us at our Chrismas festivities, but remembering, and desiring to be remembered, we send a twig from our Christmas tree." And over in one corner is "Heaven give you many, many merry days." This wide-awake company and its enterprising officers are ever on the alert for new things.

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Central station managers in the East appreciate the mild Winter. It has made coal very cheap.

That crimes, disasters, fires and great happenings occur in cycles is an axiom of newspaper men. The crank with the bomb is abroad in the land. If any of our prominent electrical people are visited by a suspicious appearing person who looks as if he might be toting explosives around, and who demands a million in money, we hope that they will give it to him.

Coldwater, Mich., local taxpayers are half tickled to death over the immediate success of the new incandescent lighting system. At the end of the first month the collector reports receipts sufficient to pay expenses of both the arc and incandescent plants, waterworks and free street lights with a cash balance in the treasury.—*Detroit Tribune.*

It is only polite to hope that the tickling sensation may remain constant.

Our electric light friends will be interested in the letter from Washington relating to the electrical needs of the government. Mr. Maynard, our correspondent, presents these needs in his entertaining way, pointing out a few governmental inconsistencies and presenting much valuable information.

Both branches of the city government of Chicopee, Mass., have voted in favor of a municipal electric plant, and thus far "no particular opposition to the plan has been developed." Looking Backward Bellamy lives in Chicopee. If his own town went back on the prophet of Nationalism, how funny it would be!

POLYPHASE GENERATORS.

The remarkable results attained in the transmission of power 108 miles by means of three-phase alternating currents and multiphase rotary current motors has created so lively an interest in electrical engineering circles that any new contribution to the literature of the subject will be widely read. A mathematical paper on "Polyphase Generators" was read before the American Institute of Electrical Engineers, on December 16, by M. I. Pupin, which is published in full in this issue of the REVIEW. Mr. Dobrowolsky has maintained that one fact contributing to the high efficiency of the three-phase motor is the small fluctuation of strength in the rotating magnetic field created by the varying value of the sum of electromotive forces in the several motor circuits, and claimed that in the quarter-phase field the pulsation would be as great as 40 per cent., developing great self-induction and cutting down the efficiency of the motor. Mr. Pupin approaches the subject in a different manner, mathematically, as distinguished from the graphical method of Dobrowolsky, and also shows that there is less fluctuation in the field as the number of current phases increases and that a perfectly constant field would be attained only when the number of phases becomes infinite; but thinks Dobrowolsky has greatly over-estimated the amount of fluctuation in the quarter-phase type. He thinks the presence of iron in the magnetic circuit largely reduces the value of fluctuation.

The discussion of the paper was especially interesting, being maintained by Professor Thomson, Messrs. Bradley, Steinmetz and Kennelly, and will be presented in the next issue of the REVIEW.

THE SEASON'S GREETINGS.

It has not yet become the accepted custom for technical journals to issue special Thanksgiving, Christmas and New Year numbers. The seasonable expression of "good will toward men," which such special issues are intended to evidence, usually takes some such form as the present writing.

Electrical people had much to be glad for on Thanksgiving, they will be about as merry as usual at Christmas and they will wish each other a happy and more prosperous New Year with a zest. The man in these times who has nothing to be thankful for is truly an outcast. He who cannot be merry at Christmas, even though he be alone and far from home, is either an unbeliever or else has forgotten his boyhood teachings. The one who is not hopeful of better times, especially at the dawning of a New Year, lacks ambition and is unworthy of his fellows. Each of us has his troubles, but on holiday occasions no one should have time for anything but enjoyment of the present.

The past year has been a fruitful one to the electrical field. Our step of progress has this time become almost a hop, skip and a jump, and yet none of us hesitates an instant to hope for and predict a longer stride during the life of 1892. The year has been marked, as usual, with plus and minus signs. The optimist would say that what we have not gained in money we have gained in experience, which is not legal tender, but equally as valuable.

As for ourselves, we are thankful for much, merry over many things, and have illimitable hope in the future. We have many kind friends whom we have tried to serve faithfully. To everybody the ELECTRICAL REVIEW sincerely wishes a very, very Merry Christmas and a prosperous and Happy New Year.

ELEVATED OR UNDERGROUND?

The New York *Sun* of December 18 contains an editorial plea for the elevated roads and attacks the proposed underground system of rapid transit, winding up with the assurance that good Mr. Gould "is simply putting his capital at the service of the public," when he asks for Battery park and other facilities for increasing the dividends of the elevated system. The *Sun* endorses Mayor Grant in saying that "the people object to traveling through a hole in the earth."

This is all moonshine. The tunnel railway system, if electrically operated, would be no more obnoxious to the public as a mode of transit than are elevated roads. Whether one climbs up or down to get a train is a matter of indifference, and with an electric system of locomotion, the air in the tunnel would be as pure as that at the surface. The equable temperature of the tunnel would make travel more agreeable. These are facts, and all the ingenious and brilliant circumlocution the *Sun* can dazzle us with cannot blot them out of sight. The underground electric system of London is so far from being objectionable on these accounts that plans are being laid for extending the system. An electrically operated system would admit of an economical introduction of elevators by which passengers could be raised to or lowered from the street level without wearing themselves out on stairs. The speeds that can be attained underground on a straight track could not be rivaled on the elevated system on account of its existing curves. The elevated roads could not give us rapid transit without a four-track system and this would necessitate a complete occupation of the streets through which they pass. Residence along these roads would be unendurable. The power of a giant corporation like the Manhattan Elevated Railway Company is very great and it is the duty of the press to carefully watch every movement in the effort to steal the streets and public parks. The *Sun*, with purring euphemism, observes:

"The cable roads, also, will be in operation by the middle of next year, and they will much increase the facilities for transportation above ground. They will not furnish strictly rapid transit, it is true, but the speed will be enough greater than it is now by horse cars to save a multitude of people from the dire necessity of traveling through the proposed tunnels."

This, if true, but makes the reason stronger why no more room should be given the elevated roads. If the cable cars will relieve congestion until an adequate system can be constructed, which will not choke the streets and will give us true rapid transit, so much the better. It is not quite evident, however, how the cable roads, with horse cars having rights of way over their tracks, can give a service that will answer for long range transit. A chain can only be as strong as its weakest link. So a car system can be only as rapid as the slowest car. It would be a blessing to the community if all surface vehicle traffic were put underground. People would then have a few more chances of life in crossing a street and the tension taken off their nerves would add years to their length of life. Such a result is at present purely Utopian, but an adequate underground system of rapid transit would so generally absorb long range transit that surface conveyances would not struggle to compete and the dangers of foot travel would be greatly mitigated.

New York and her suburbs badly need rapid transit, but she will not submit to have the light of heaven further shut out by the elevated roads.

The United States Portelectric Company, whose doings are mentioned in another column, has got hold of a good idea with a number of good men to push it. Apparatus for the rapid transit of mail matter by electricity has been developed experimentally by several inventors. The building of a commercial line is but a natural and progressive step by which it is hoped to show that the fundamental ideas on this subject have not been amiss.

CORRESPONDENCE.

OUR MEXICAN LETTER.

The Mexican Telephone Company are now busily engaged in overhauling their entire plant in the City of Mexico. Iron poles made by Milliken Brothers, of New York, are being set and up to date 50 have been raised. The Standard Underground Company's cable has been selected as the kind to be used and already several thousand feet have been strung. The company has at present nearly 1,000 wires in the principal streets of the city, which will all have to be removed and run through cables to the central office. Already about 50 subscribers have been connected through the new system, which is giving good satisfaction. In a few days the first route leaving the exchange will be completed and the work of taking down the wires and the wooden poles will be commenced in earnest. The new terminal board, at present, will accommodate 1,500 subscribers, with additional room for 2,000. No doubt, as soon as the new construction work is well under way and the service improves, the exchange will rapidly increase in number of subscribers. At present very little canvassing is being done on account of having to run the lines for new subscribers which, in a very short time, will all have to be taken down and run through the cables. The company has recently issued its first monthly list of subscribers which, in future, will be published and distributed on the 15th of each month, thus affording subscribers to keep track of the new additions.

A New Switchboard is now being built in their shops for the Tacubaya Exchange, which is connected with Mexico City by trunk lines. New cables, cable boxes and terminal board will be put in, also five more new trunk lines run, affording ample number to carry on the business between the two places.

The Company, as soon as the new construction work is completed in Mexico City, intend overhauling each of their sub-offices, of which there are five, putting them in first-class condition, both inside and outside.

The Company has recently overhauled their exchange at Puebla, putting in cables to office poles, terminal board and cable boxes, in fact, a general overhauling of the inside plant, with a view of improving and increasing the service.

A repair shop is also being fitted up, where any kind of electrical apparatus can be repaired, thus affording the people a chance to have their work done at home, and at the same time a saving of time and money.

In addition to their telephone business, they intend handling a complete line of electrical supplies, including telephone, telegraph, electric light, electric bells, hotel annunciators, watchman's clocks, etc.

TRANSMITTER.

City of Mexico, December 12, 1891.

OUR ALBANY LETTER.

The Rights of Way for the construction of the Saratoga Electric Railway, to Saratoga Lake, have been secured, and Mr. William M. Truman, who is to be its superintendent, says that the road will be in complete running order by June 30, 1892. The road will be nine miles long. Car barns, etc., will also be erected.

Electrician William H. Cull, of the local branch of the Hudson River Telephone Company, has gone to Richmond, Va., to look up further a more perfect plant of the Law system of telephony. He says that there are many things in the Law system that he likes, and it looks as if the Hudson River Telephone Company had not yet entirely abandoned the idea of adopting it for their plant.

The Meneely Bearing Company, of West Troy, N. Y., has equipped the motor cars of the Albany Railway with its new bearing—called the Meneely roller bearing. It is formed of a number of steel rollers and greatly reduces the friction in the journal. It requires scarcely any lubrication and from practical tests has been found to save largely in dynamic electricity. The ten large and handsome new cars being built for the Albany Railway, at the Gilbert Car Works, Troy, N. Y., are also being equipped with the new roller bearing. The cars on the Troy and Lansingburg road also have the invention in use.

As Yonkers, N. Y., is discussing the project of an electric street railway, the editor of the Yonkers *Gazette* has mailed the following circular to the Mayors of 100 cities: "Sir—The government of our city is discussing the advisability of permitting the introduction of the trolley system of street cars in our principal thoroughfares. Will you oblige our citizens by briefly answering the following questions: 1. Do you consider that the trolley system has been operated successfully in your city? 2. If not, do you believe it to be the fault of the system, or of the management? 3. If successfully operated, has it benefitted the business interests of your city? 4. Which of the trolley and motor systems is in use in your city? 5. Do you consider the system which you have the best of all now in use? 6. Have any persons in your city been killed by the electric current from the trolley line? 7. If so, how many? 8. Are such accidents very liable to happen?" The replies thus far received have been entirely favorable to the electric railway and have characterized it as a child of progress and a general aid to business. L. M. W:

Albany, Dec. 19.

OUR CHICAGO LETTER.

Personal.—E. T. Orne, of the Orne Electric Construction Company, has gone to New York city on business.

Incorporated.—The Newman Electric Light Company, Newman, Douglas County; capital stock, $6,000; incorporators, J. P. Heaton, J. L. Barkley, George W. White, J. L. Todd and Scott Burgett.

The Cook County Abstract Building is being wired throughout with Simplex wire, the work being done by the Chicago Edison Company. Both the wire and the Flexite tubing is furnished by George Cutter.

President Yerkes, of the Chicago City Railway Company, claims to have made arrangements with Wright & Mysenburg to purchase the right to operate street railways under the Siemens & Halske system if it proves a success. An experimental line will be built on Twelfth street soon.

The success which the New York Insulated Wire Company have met with their Vulca duct system is unprecedented. Among the many buildings that Vulca ducts have lately been installed in are those of Dixon Crucible Works; Wausau Court House, Wausau, Wis.; Pabst Hotel, Milwaukee; Mans Office Building, Indianapolis, and many other small installations.

An order for four sets of Burton electric heaters from the Aspen Mining Company, Aspen, Colo., has been received by the Electric Merchandise Company, Chicago, to be used in the mining company's motor stations. Further companies placing recent orders are the Benson and Halcyon Heights Railroad Company, Omaha, Neb.; Edison General Electric Company, Portland, Ore.; Maschinenfabrik Oerlikon, Oerlikon bei Zurich, Switzerland; Newburyport and Amesbury Horse Railroad Company, Newburyport, Mass.; Warrensburg Electric Light Company, Warrensburg, Mo. M. J. B.

Chicago, December 19.

OUR BOSTON LETTER.

Mr. R. H. Whittier, of the firm of Drake, Payson & Whittier, Providence, R. I., electrical engineers, was among the visitors to this office recently.

The American Electrical Works, of Providence, R. I., has kindly remembered this office with a Christmas souvenir consisting of a handsome card conveying the choicest sentiments and kindest wishes.

The Boston and Great Falls Electric Light and Power Company, Montana, has declared a dividend of one dollar a share payable January 1, to stockholders of record December 28. This is one of several Great Falls enterprises controlled by Boston capital and the first on the list to declare a dividend.

The W. T. C. Macallen Company, manufacturers of solid mica insulators, have established themselves in business at No. 161 High street, this city. Mr. Louis McCarty, the general manager of the company, has been identified with the Gould & Watson Mica Company, also of this city, for several years.

The Thomson-Houston Electric Company has declared a semi-annual dividend of 3½ per cent. on the preferred stock, payable January 1, to stockholders of record December 22. It is said that the profits of the Thomson-Houston Electric Company for the 10 months ending December 1 were over $1,700,000. W. I. B.

Boston, Dec. 19.

A Generous Present.

Mr. John W. Mackay, president and principal stockholder of the Commercial Cable Company, in accordance with his usual custom, has instructed the cashier of the company to pay every employé an extra half month's salary as a Christmas present. The gift is from Mr. Mackay's private purse, and probably amounts to $20,000.

Death of Senator Plumb.

Senator Preston B. Plumb, of Kansas, died suddenly of apoplexy at 11.50 A. M. Sunday, December 20, in his apartments at Washington, D. C. Senator Plumb was the most industrious man in the Senate, and in many ways the most forceful. He had had considerable to do with electrical enterprises. Senator Plumb was the most popular man in Kansas, where his loss will be most keenly felt.

EMINENT ELECTRICIANS.

FACTS ABOUT FAMOUS MEN WHOSE NAMES WILL ADORN THE ELECTRICITY BUILDING AT THE WORLD'S FAIR.—BY DR. P. H. VAN DER WEYDE.

VI.

Maxwell—James Clerk (1831–1879); Scotch physicist. Had a very thorough scientific education, first in Edinburgh, later in Cambridge, then in Peterhoven, and moved to Trinity. Became professor of natural philosophy in Aberdeen, then in King's College, London, and lastly superintended the organization of the building and equipment of the Cavendish laboratory. In 1859 he obtained the prize at Cambridge, and the Rumford medal in 1860, for some of his achievements in optics and astronomy. He published also a celebrated text-book on the modern theory of heat, and on matter and motion; but his chief attainments were in electricity, and being a far greater mathematician than Faraday, he, as it were, translated Faraday's experiments into a mathematical system similar to the old hypothesis of Descartes, which was based on the existence of an imponderable fluid, moving in vortexes, and acting upon solids, and so explaining the electric attractions and repulsions. Poisson defended the idea of action at a distance, as in the case of gravitation, while Weber devised a very ingenious theory of the same kind, but Maxwell did not agree with these theories, and adhered to the old idea of an imponderable fluid called ether, by the motion of which he attempted to explain all the electric phenomena discovered by Ampere and Faraday. Maxwell discovered relations between the velocity of the transmission of light in vacuo and the electro-magnetic and electro-static units, which make it highly probably that the undeniable existence of the medium which transmits the light plays the most important role in electric phenomena, as was suggested more than 100 years ago by the blind German philosopher, Euler. The last labor of Maxwell was the publication of "Electric Researches of Cavendish," which showed that this investigator was a man of the first rank in scientific attainments.

Siemens—William (1823–1883); German physicist and inventor. Finding that English patent laws furnished him the protection which he could then not obtain in Hanover, which was his country, he made England his home and became, in 1859, a naturalized British subject, after he had been there in practice as an engineer since 1851. He worked very hard on two subjects—heat and electricity—and combined what is not often found together—theoretical scientific talent and practical business ability. His merits were recognized by his election to the Royal Society in 1862; to the British Association; the Iron and Steel Institute; Telegraphic Engineers; etc., and last became president of the Institute of Mechanical Engineers, while many other honors were heaped upon him by other countries. He attempted to improve the steam engine as a converter of heat into work, but did not succeed in all respects, except in economizing heat, especially by his regenerating furnace, which has become famous and was applied in various establishments, but became most successful when Siemens himself applied it to the manufacture of steel directly from the ore. But his greatest achievements were accomplished in the field of electricity. In 1860 he invented, with his brother, Werner, the peculiar winding of the armature called after him, and was a pioneer in magneto electric improvements. He astonished the world in 1867 by communicating a paper to the Royal Society on "The Conversion of Mechanical Power Into Electricity Without the Aid of Permanent Magnets," and then he began the construction of dynamos, which soon were imitated by Weston, Hopkinson, Edison and others. He mostly used the electric arc light, and also applied this for the reduction and fusion of refractory metals.

Weber—Wilhelm Edward (1804–1867); German physicist. Educated at Halle. In 1825 he made a name as author of a treatise on the wave theory in connection with the propagation of sound and light, which is still considered a standard work, and in consequence of which he obtained an appointment, first in his *alma mater* and later in Göttingen, as professor of physics, from which, however, he was discharged in 1843 by the government of Hanover, for expressing liberal opinions in politics. Leipsig, a more enlightened city, called him there at once; he remained till 1849, when he was reinstated in Göttingen. His labors in the field of electricity and magnetism were very extensive, especially in magnetism. He published, in connection with Gauss, in 1837–1840, the results of the investigations on terrestrial magnetism, with an atlas, which resulted in the establishment of an entirely new theory on this subject. From 1846 until his death he published a series of treatises, entitled, "Electro-Dynamic Measurements."

Wheatstone—Charles (1802–1875); English physicist. He was educated in private schools and not considered a smart boy; he had a morbid temperament and was always one of the lowest of his class, wherefore his father sent him, in 1816, to learn a trade with a musical instrument maker, who was his uncle. He never did like to study a task prescribed, nor to work at a job given him to do, but liked better to read books of all kinds. His father indulged him in this, hoping that the boy would at last find something congenial at which he would work with ambition; this was, indeed, the case. Young Wheatstone became much interested in acoustics; he set to work and devised several new and ingenious arrangements. In 1823 he published his first paper—"New Experiments on Sound"—which was translated in several continental languages. This encouraged him, and most of all that Faraday, in his regular lectures, often described Wheatstone's devices, as the latter himself was too shy to lecture. His merits, however, caused him to be appointed as lecturer at the King's College, London. As eight lectures proved no success it was given up, notwithstanding the importance of the subjects he treated. The rapid transmission of electric currents suggested to him an electric telegraph, for which, in 1837, he obtained a patent, jointly with Cooke; in 1837 he was elected a fellow of the Royal Society, and in 1868, after he had completed his masterpiece, the automatic telegraph, he was knighted, whatever that amounts to. His last work was perfecting a receiving instrument for submarine telegraphy; this caused him to get pneumonia, which carried him off rapidly. He was very active in many other departments of physics, and in his ripe years distinguished himself as much by his extraordinary intelligence as in his boyhood he was famous for his backwardness. One of the strongest proofs of his ingenuity was the invention of the Wheatstone bridge, a superior specimen of his perspicuity, and which has become indispensable to every practical and theoretical electrician. His many labors in other branches of physics we must pass over, but we must still add that he was the inventor of the revolving mirror, which ingenious device has done so much for the determination of the velocity of the electric current and other details of various electric and non-electric researches.

PERSONAL.

Mr. A. H. Chadbourne, of Philadelphia, spent an hour or two in the metropolis last week.

Mr. W. J. Morrison, of the Fort Wayne Company, was in New York several days recently.

Mr. W. A. Stadelman, of Philadelphia, a well known electrical engineer, visited New York last week.

Captain Eugene Griffin, vice-president of the Thomson-Houston Electric Company, visited the city last week.

Messrs. John C. English, of New Haven, and J. M. Orford, of Bridgeport, Conn., were recent metropolitan visitors.

Past-President Elihu Thomson presided at the meeting of the American Institute of Electrical Engineers held December 16.

Superintendent Khotinsky, of the Germania Electric Company, Boston, has returned with his family from Europe.

Mr. George L. Briggs, superintendent of the Eddy Electric Manufacturing Company, Windsor, Conn., is suffering with the grip.

Mr. S. M. Bryan, of Washington, D. C., was noticed hurrying about the Cortlandt street telephone building one day last week.

Col. E. L. Babcock, president of the Falls Rivet & Machine Company, Cuyahoga Falls, O., the very successful clutch pulley manufacturers, visited New York last week.

Mr. William Hazelton, of Philadelphia, special agent of the Short Electric Railway Company, Cleveland, spent a day or two in New York last week and called at the REVIEW office.

Mr. and Mrs. H. H. Eustis, on their return from their wedding trip, will reside at 3 Walnut Terrace, Brookline, Mass. Mr. Eustis is well known as the president and electrician of the Eastern Electric Cable Company, of Boston. The bride was Miss Orient Humphrey Nichols, of Boston.

Mr. John A. Barrett, electrical engineer and expert, has opened an office at 13 Park Row, New York. Mr. Barrett is one of the ablest young electrical engineers of the day, careful and conscientious in all his work, and the REVIEW is pleased to learn that he has again become actively identified with electrical work.

Telephonic News

*** The Pennsylvania Telephone Company has completed the construction of a new line to Lancaster from Reading, Pa. New wire and new poles were used.

*** The managers of the various telephone districts in New Jersey last week visited the Paterson telephone exchange, enjoyed the hospitality of Manager Noonan and examined his way of running things. Among those present were Charles M. Root, of Elizabeth; William H. Brush, of Newark; Charles Runyon, of Plainfield; C. J. Quimby, of New Brunswick; A. W. Blake, of Long Branch; W. H. Minster, of Jersey City, and C. E. Gunning, of Morristown.

*** Some time ago the councils of Chester, Pa., passed an ordinance taxing all telegraph and telephone companies 50 cents on each pole erected in the city. The Western Union and the Delaware and Atlantic Telephone and Telegraph Companies objected to this, and on their refusing to pay the tax the matter was taken into court. Last week Judge Clayton handed down a decision affirming the city's right to collect a tax on the poles, and in case of refusal to cut the poles down.

*** January 1 will see several important changes of the officials of the Central New York Telephone Company. W. H. Girvan, general superintendent, with headquarters at Syracuse, has handed in his resignation, to take effect at the end of this year. He has accepted a more lucrative position with the Syracuse Electric Light and Power Company. The directors of the company have accepted his resignation and appointed Walter W. Nicholson to be his successor. Geo. W. Wood, who has been a division superintendent in Herkimer county, with an office in Little Falls, will succeed Mr. Nicholson as division superintendent for Oneida, Madison and Lewis counties.

Loppy Had Four Shocks.

The certificate of the execution of Martin D. Loppy, at Sing Sing, on December 7, was filed with the County Clerk last week. The affidavits of Drs. Carlos F. MacDonald and Samuel B. Ward say that while Chaplain Edgerton was conducting religious services, the prisoner walked to the chair, and quietly submitted to the adjustment of the straps and electrodes. There were four short contacts, occupying in all 52 seconds, divided as follows: First, 15 seconds; second, 11 seconds; third, 15½ seconds; fourth, 10½ seconds. The electrodes were moistened before each contact.

Professor Laudy found that the current measured 1,716 volts and seven amperes. An examination made immediately after the last contact showed that the prisoner was dead. The physicians say that death was apparently instantaneous and painless.

Dr. Ira Van Giesen, who made the autopsy immediately after the fact of death was ascertained, makes a long statement. It was found that *rigor mortis* was almost, if not entirely absent, except in the right leg. The mouth and nostrils showed no trace of the extrusion of fluids or frothy matter. The only eye that Loppy had was in a natural state. There were no discolorations or contusions, except at the knee where the electrode was applied, and at the cheeks where there were marks made by the restraining straps. At the knee there was a superficial reddishness, 3½ by 5 inches, but the true skin bore no mark whatever. There was no mark under the head electrode. No signs of violence were shown in the muscles of the body.

Comparing this case with the four previous executions at Sing Sing, Dr. Van Giesen says a current of 1,400 to 1,600 volts does not damage the internal organs, tissues or muscles. He says the local thermic effects of the electrodes were limited to the outer scarf skin. Parts of the skin which had been exposed to the weather, as in the forehead and scalp, were not blistered. Compared with the four previous executions, the changes in the skin were even less and might be pronounced altogether trivial.

Anti-Induction Device for Telephone Circuits.

Many efforts have been made by inventors to neutralize the disturbing effects of cross-induction between telephone circuits and other circuits which pass near them. The disturbing effect of light and power circuits is very serious, especially in cities where the two styles of circuits are necessarily brought into more or less close relationship. The most recent plan proposed for correcting this difficulty is that of Messrs. William Stanley, Jr., of Pittsfield, Mass., and John F. Kelly, of New York. The invention is based upon the fact that the self-induction and capacity of an electric circuit over which a current of a given periodicity or number of waves per unit of time is flowing may be adjusted relatively to each other and to the said current, so that only the dead resistance of the circuit will be opposed to the passage of such current. In general, if n be used to denote the number of complete waves of the current per second, L, the co efficient of self-induction of the circuit, and M, its capacity in microfarads, then any line that possesses the necessary values of L and M in the equation

$$n = \frac{10^3}{2\pi\sqrt{LM}}$$

(the mathematical expression of the law, in which the other factors are constants that need not be considered herein) will offer no other opposition to a current of n waves than that of ohmic resistance. It is obvious, however, that for all other frequencies an opposition other than that of ohmic resistance will appear, for higher frequencies, due to an unbalanced self-induction, for lower, to an unbalanced capacity. As the capacity introduced continues to neutralize the self-induction to some extent for all frequencies, all rates above the normal will get through more readily than if no capacity were present, although the farther they are from the normal the less will they be helped. It is otherwise with lower frequencies. Here the opposition is due to the capacity, the new element introduced into the circuit, and for rates a certain amount below the normal, the opposition offered by the unbalanced condenser is greater than that previously afforded by the self-induction alone.

Fig. 1

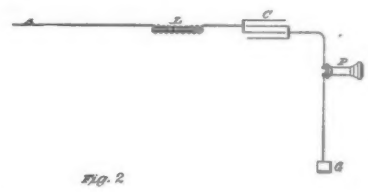
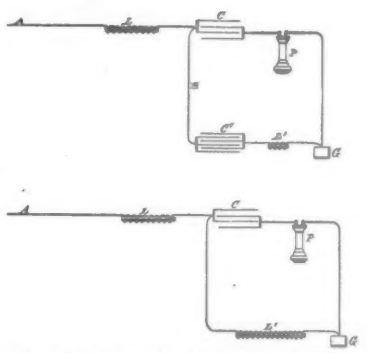


Fig. 2

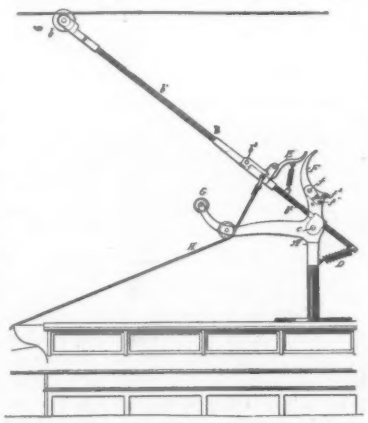


In carrying out the invention there is interposed in the circuit, between the receiving 'phone and the line, a self-induction coil and a condenser to which such values are given that they will operate to hinder to the greatest possible extent the propagation of current waves of a frequency below a certain predetermined limit, but permit the speech-producing currents, which are of much higher frequency, to pass without material opposition.

One mode of carrying out the invention is illustrated in the accompanying engraving. If the line A be in inductive proximity to an alternating current light or power circuit over which currents of a low number of waves are passing, the disturbance in the 'phone may be so great that it may be arrested by introducing between the receiver and the line the self-induction coil L and the condenser C. The relative value of these devices may be adjusted by varying the length of the coil and the size of the condenser, so as to hinder to a very great extent the propagation of waves of a frequency below a predetermined limit, while checking to but a slight extent or even favoring those corresponding to and producing speech, so that telephonic communication may be carried on without serious interference from those induced or leakage currents which now so frequently render communication impossible. In Fig. 2 a modification is shown by the addition of the shunt S from line to ground around the condenser and receiver, which is so adjusted as to capacity and self-induction by means of the condenser C', of comparatively large capacity, and the self-induction coil L, of comparatively low self-induction, as to possess a high degree of receptivity for long waves. In Fig. 3 is shown a similar arrangement, except that the shunt S is arranged to have a high self-induction and a low resistance, which would tend to shunt the long waves and oppose the short. So in various ways there may be placed in the circuit a means of hindering the propagation of long waves in the coils of the receiving 'phone, while not checking those corresponding to sound waves, and such long waves may be shunted around the said receiver by a circuit of high receptivity for such waves, or of a low degree of receptivity for those corresponding to articulate speech.

Trolley for Electric Cars.

In the accompanying engraving is illustrated an improved trolley arm, recently patented by John W. Schlosser, of Washington, D. C., designed to guard against injury to the line or to the trolley when the trolley wheel bounds from the conducting wire, as often happens in railway service. In lieu of the rigid bar upon which the trolley wheel is mounted ordinarily, this device comprises a bar composed of two hinged parts normally locked together by means of a latch E, so that so long as the trolley maintains contact with the conducting wire the bar B acts as the ordinary trolley bar. In case the wheel b should bound away from the conducting wire and the bar tend to rise above its ordinary position, the latch E will be forced against a stop F which will unlatch the bar and permit the upper part to fall back upon the hinge b^3 and bear against the support G. To restore the trolley wheel to its proper position, the car operator will then pull upon the cord H, which will straighten out the bar and latch the two hinged parts together. Stop F is made adjustable so that the trolley can be accommodated to conductors supported at different heights.

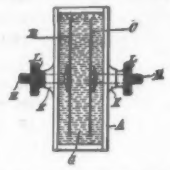


Club vs. Electricity.

Warden Brown, of Sing Sing, has made an official report of the electrocution of Loppy. He says that four contacts were necessary, and that the total electrical application lasted 52 seconds. No doubt Warden Brown considers this time of torture brief, but he could have killed the man with a club in one second.—*N. Y. Morning Advertiser.*

Oil Condenser.

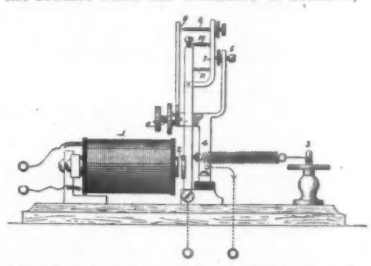
With a view to improving the insulating medium between the plates of a condenser to adapt them more perfectly for use with alternating currents of high frequency, Nikola Tesla proposes to use oil as the insulating material. One form of apparatus is illustrated in the accompanying engraving, wherein is a box provided with condenser plates, B, C, separated by a body of oil contained within the receptacle. The



construction admits of adjusting the distance between the plates, which is of advantage for graduating the condenser to the particular work for which it may be required. The plates are, therefore, mounted upon rods extending through stuffing boxes in the sides of the receptacle, and their distance apart may be graduated by adjusting the thumb screws L on the outside of the receptacle.

Relay.

In relays as ordinarily constructed currents of very brief duration will actuate the armature, thus permitting effects of static charge or discharge to interfere with a reliable action of the instrument. In order to overcome this difficulty Richard Varley, Jr., of Englewood, N. J., constructs a relay as illustrated in the accompanying engraving. The armature is provided with a yielding contact for retarding the closure of the local circuit, the retardation being produced by the inertia of the contact when the armature is actuated,



whereby the movement of the contact is made a little later than the movement of the armature to which it is connected. With currents of exceedingly short duration this lagging in the time of movement permits the armature to move forward and commence its backward stroke before the lagging contact has closed its circuit, and therefore the circuit controlled by the relay is unaffected by the brief disturbance designed to be ignored. The pivotal contact is illustrated at 7 in the drawing, and is held against a stop 11 screwed to the armature by a very delicate spring 10. When the armature is drawn forward suddenly, under an impulse of current, the pivotal portion 7 does not start with it immediately, but lags until, when the spring 10 is brought under stress, the armature is brought up against the front stop 9, and the local circuit is closed. It thus requires a closure of the main circuit during a definite interval to affect the local circuit.

Chicago Electric Club.

On Monday Evening, December 14, a most enjoyable burlesque town council meeting was held. Proposals for an imaginary electric light plant were received. The entertainment was finished with recitations by members of the Club.

Boston Electric Club.

Although the Boston Electric Club has given up its house and disposed of its furniture and effects, its charter has not been surrendered. The Club will, hereafter, be perpetuated by monthly dinners, lectures and the like.

The Constitution and By-Laws have been revised and the dues reduced to a nominal figure.

On the Evening of January 4 the Club proposes to hold its inaugural dinner.

Broad Electric Railroad Patents.

TWO INTERESTING CASES.

On December 15 two patents were issued to George F. Green, of Kalamazoo, Mich., for electric railways, containing very broad claims, which will have an important bearing on the electric railway art, and which will probably be more important in the near future when interurban electric railways are developed, and supply circuits formed by the rails are used. The mechanism shown in the patents is very crude compared to the refinements of electric railway apparatus of to-day. One of the applications upon which the patents are based was filed September 15, 1879, and the other May 15, 1886, and the cases have been involved in hotly contested interferences in the patent office during most of the period between the dates of filing and the present. The broader patent issues pursuant to a decree of the supreme court of the District of Columbia, which overruled the commissioner of patents in rejecting the application. The drawings accompanying the patent are illustrated in the accompanying engraving, wherein J represents the operating motor, K represents a source of current supply, which connects with the rails, the latter being insulated by blocks D of insulating material. The broadest claim is as follows:

The combination, substantially as set forth, of a railway track, one or more stationary means of electric supply, electrical conductors extending from said means of electric supply along the lines of said track, and consisting wholly or in part of the rails thereof, vehicles movable along said track, electro-dynamic motors fixed upon said vehicles for imparting motion thereto, and wheels supporting said vehicles upon the track, and also serving to maintain continuous electrical connection between said means of electric supply and said motors, substantially as described.

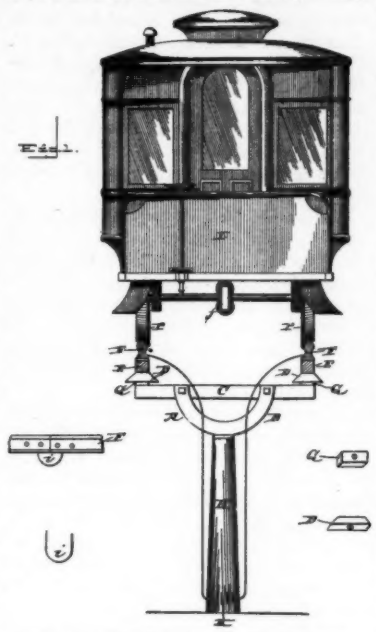


FIG. 1.—GREEN'S ELECTRIC RAILWAY.

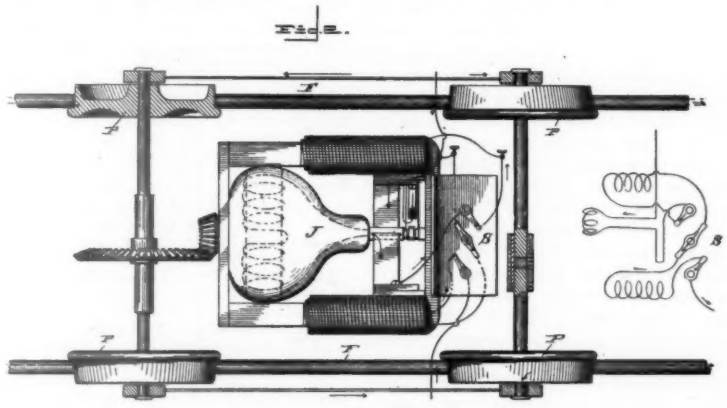


FIG. 2.—GREEN'S ELECTRIC MOTOR AND TRUCK.

This claim covers apparently any mode of operating an electric railroad by which the current is led to the traveling motor by means of the rails and enters the motor through the wheels of the vehicle upon which it is mounted.

The second patent is more specific in character, involving, in addition to the elements recited in the above mentioned claim, a circuit controller for the car motor. The broadest claim of this patent is as follows:

The combination of one or more sources of electric supply, a railway track, a wheeled vehicle moving upon or along said track, a conducting circuit composed wholly or in part of insulated conductors extending along the line of travel of said vehicle, one or more rotating electric motors mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit-controller placed on said vehicle and also included in said circuit of conductors, substantially as described.

Fig. 2 is an illustration of the system described in this patent, the detail view showing the connections of the circuit controller.

Engineering Association of the South.

The regular December meeting of the Engineering Association of the South was held at the new headquarters of the Association in the Cumberland Publishing House, Nashville, Tenn., on the evening of December 10. In the absence of the president and both vice-presidents, Mr. Hunter McDonald, of Atlanta, Ga., engineer in charge of the Western & Atlantic Railroad, presided, with about 30 members and visitors present.

Applications for membership in the Association were received from Mr. William Hewitt, engineer and vice-president of the Trenton Iron Company, Trenton, N. J., and Mr. J. S. Walker, United States assistant engineer in charge of construction of locks on the Cumberland river improvement. The secretary presented the specifications governing the competition for the cash prize of $1,000, offered by the Board of Public Works of Duluth, Minn., for the best plans for a drawbridge across the ship canal at that place.

The paper of the evening, entitled "Refrigerating Systems," was then presented by Dr. Wm. L. Dudley, of Vanderbilt University, Nashville, Tenn.

The new headquarters of the Association, occupied for the first time at this meeting, are in one of the most desirable portions of the business quarters of the city. The principal room is 43x23 feet with excellent illumination and has been neatly fitted up at the expense of the local members. Already a large list of exchanges have been received and an order is now out for a full list of all the leading technical journals. Non-resident members and other engineers visiting Nashville are cordially invited to visit the rooms and make them their headquarters while in the city. Stationery and draughting accommodations will be found here for the benefit of the membership and guests.

Electric Transmission of Power in Germany.

The Royal Factory of Machinery, at Kœningsburg, had, until recently, its different workshops distributed in different localities around that city; this, however, made it necessary to transport the rough heavy castings from one shop to another in order to be finished. There were, for instance, the hammer works, driven by water power, in one locality; the turning lathes were at another place, where steam power was used, while the high furnaces for the reduction of ores were near the railroad station, where the raw material was dumped with the minimum of extra labor.

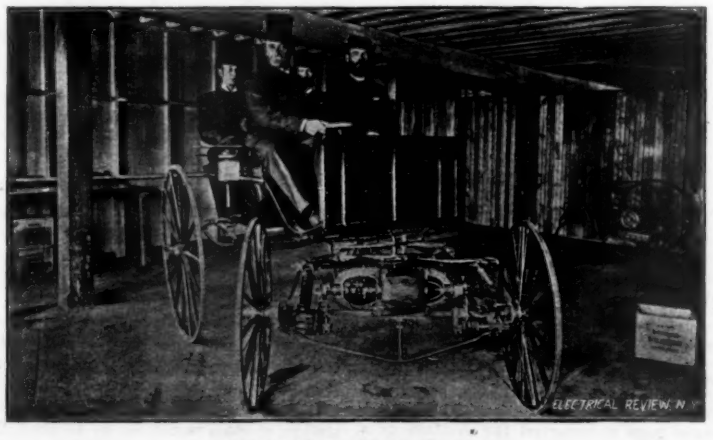
It had been for a long time contemplated to transmit the water power to the latter locality, either by wire transmission or by flumes. The wire transmission was objectionable for reason of the many roads to be crossed, among which was the railroad, while the peculiar situation made it necessary to lead the wire around corners; this idea was soon abandoned, while the transmission of water itself by flumes was out of the question. No wonder, then, that soon the electric transmission was decided upon, when its possibility was demonstrated.

In order to execute this project, a survey was made, which proved that the water power was equal to 900 second-litres, by a fall of 3.6 metres, which means that every second 900 litres, or nearly 2,000 pounds, fell 12 feet, equal to 24,000 foot pounds per second, which is equivalent in round numbers to 1,500,000 foot pounds per minute, or about 145 horse-power. The distance from the water power to the steam engine was about 500 metres (1,650 feet). The output of the turbine at the water power was rated at 75 per cent., and that of the two dynamos at 90 per cent. of this. These estimates were based on the experiments of Professor Dietrich, who, in 1889, gave a very thorough lecture on the available output of dynamos and electric transmission of power, which was published in 1889, and this ratio of only 90 per cent. available in the dynamo has since become fully verified as very near the truth in all good dynamos. This gives, counting the two losses, 34 horse-power transmitted, which, estimating the loss in the secondary dynamo or motor, also 10 per cent., leaves 30 horse-power, minus the loss in the conductor by resistance. The conductors were double and made of silicon bronze, while the spans were long—some of them as long as 300 metres (950 feet), over all houses and trees, and out of reach of doing injury, but, in addition, it must be stated that the current was only 600 volts, and thus not very dangerous.

For safety four wires are used—two for the direct current and two for the return current—so that if one breaks, the transmission of power is not interrupted.

As the power needed was large, it was found necessary to increase the amount of water power thus far used for the hammer works, by adding to it other sources, like the Etzelberger Lake, which was disposable for this purpose.

Since January, 1891, this plant has been in operation night and day, except Sundays. Thus far the final output has been found to be 77 per cent. of the theoretical power at the falls, and thus better than the original estimate, which was chiefly due to the fact that the output of the turbine was found to be better than it was estimated, and over 80 per cent., in place of 75, as rated.



LUGO'S ELECTRIC CARRIAGE.

The Mobile, Ala., city council advertises for bids to erect an electric lighting plant of 200 arc lights for the use of the city. The public lighting service is now performed by a private corporation. At the same time the city advertises for bids for lighting the city by electricity.

TELEGRAPHIC

.... Wires have been ordered underground at Savannah, Ga.

.... The Southern Pacific Railway has supplied the places of all the striking telegraph operators and the strike is ended.

.... President Harrison's recent message contained over 17,000 words, and required about five hours to transmit by telegraph.

.... Despite the war in Chili, the Central and South American Telegraph Company is expected to earn as much this year as it did in 1890. Earnings have increased a good deal of late.

.... Extensive repairs are being made to the government coast line telegraph, near Norfolk, Va., which will be completed in about a week or ten days. Eight hundred cypress poles and 170 miles of wire have been used in the renewal of the line, which will be in tiptop condition.

.... A St. Paul man sued the Western Union Telegraph Company for $2,000 damages for failure to deliver to him a telegram announcing the death of his brother in Chicago. His allegation set forth that through this failure the plaintiff "was deprived of the satisfaction and pleasure of seeing his said brother and being present at the funeral."

.... The United States officials located in Minneapolis, Minn., are having some little difficulty with the Western Union Telegraph Company. It seems that not long ago the government inaugurated a schedule of rates for telegraph business in the department, against which the company made a decided kick, and the result was that the matter is now pending for an adjustment by the department at Washington.

.... An action was brought last week by the Western Union Telegraph Company against W. B. Dickerman, as president of the New York Quotation Company, and an injunction issued by Judge Bischoff, of the Court of Common Pleas, coupled with an order to show cause why the injunction should not be made permanent. This is a result of the fight between the New York Stock Exchange and the Gold & Stock Telegraph Company.

.... The board of governors of the New York Stock Exchange, at a meeting held last week, issued an ultimatum to the Gold and Stock Telegraph Company that after 12 o'clock of last Saturday that company must pay $100 per day to the Exchange, or no longer have furnished to it the quotations which it sends over its ticker lines. These quotations have been furnished free to the telegraph company since June 5, 1889. Before that the company had reporters of its own on the floor. The Stock Exchange has since instituted a ticker service of its own, which, it is said, is patronized by most of the members of the exchange.

Lugo's Electric Carriage.

The electric carriage illustrated herewith is the invention of Dr. Orazio Lugo, electrician for The Electric Road Carriage Company, of Boston, Mass. This company owns all the sole rights, patents and future improvements of Dr. Lugo relating to motors and secondary batteries as applied to road carriages, tricycles, and all vehicles, except tramcars, for the United States and Canada. In the background of our illustration is seen one of Dr. Lugo's electric tricycles.

The method of operating the carriage is apparent from the picture. A motor is suspended beneath the forward part of the vehicle and suitably geared with the wheels. A set of storage batteries weighing 360 pounds is placed under the rear seat of the carriage. It is said that with this equipment the motor develops three horse-power, and that the batteries will furnish current to propel the carriage 60 miles in six hours without recharging.

* * Gadsden, Ala., is getting ready to replace her dummies with electric cars.

* * The Worcester, Leicester and Spencer, Mass., Street Railway Company has carried, from August 18 to December 1, over 298,000 passengers.

* * The city council of New Berne, N. C., has granted a franchise to build and equip an electric street railroad to William C. Clarke, of Wakefield, R. I.

* * The Toledo *Bee* says there is as much excitement produced on the streets by the chase of the electric car repair wagon nowa-days as by the fire department runs.

* * Mr. J. D. Wilkes has resigned as superintendent of the East Side and Whitman, Mass., electric lines. Mr. Horace Rogers has been appointed to fill the vacancy.

* * The Central Electric Company, Chicago, have just taken the agency for Illinois, Missouri, Nebraska and Indiana for the Interior Conduit and Insulation Company, and will carry in stock at Chicago, St. Louis, Kansas City and Omaha, a sufficient supply to meet the demands of the business. This is a very important agency, and the Central Electric Company can be congratulated on securing it.

A New Trolley Wheel.

Among the recent electric railway novelties is a trolley wheel and harp manufactured by the New York Electrical Works, 155 Leonard street, which is meeting with favor on account of its reputation for living to a ripe old age. It is the invention of Mr. T. J. McTighe, of the well-known engineering firm Barry & McTighe, and is the result of a painstaking effort to squarely meet the requirements of a perfect trolley. The wheel is of the self-oiling type, having a large internal oil chamber for a fortnight's supply of oil; but the oil cannot escape when the wheel is in motion, owing to centrifugal action. When motion ceases a trifle of oil gains access to the shaft which is held stationary in the harp. So there can be no spattering of oil down on the car roof. The main feature, however, is the material of the wheel. It is an entirely new type of bronze, silvery in color, tough, fine texture, non-oxidizable and is not injured by the slight sparking sometimes observable between wheel and trolley wire. The surface of contact becomes polished by use. The wheel is credited with nearly 15,000 miles travel and is said to be reliably good for 10,000 miles under average conditions.

McTighe's Trolley Wheel.

Compensating Shunt Coils for Galvanometers.

When a shunt is used to reduce the deflection of the needle of a galvanometer, an extra path for the current is thereby provided and "of course, the addition of a shunt to any portion of a circuit lowers the resistance, and therefore alters the conditions of the whole circuit and increases the current, unless an extra resistance is inserted somewhere else to compensate for the action of the shunt." ("Electricity" John T. Sprague.) A combined resistance and shunt box, which will remedy the source of inaccuracy referred to in the above paragraph, is the latest invention of Mr. Charles P. Frey, electrician for The E. S. Greeley & Company, New York. The apparatus consists of these shunts calibrated to the usual $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$ proportion, and an additional resistance subdivided into three sections known as compensating coils. These compensators are operated in connection with the shunt coils by means of a single plug. Figs. 1 and 2 illustrate this device. Any selected shunt coil and appropriate compensator can both be thrown in circuit by inserting the plug in one of the holes marked $\frac{1}{9}$, $\frac{1}{99}$ and $\frac{1}{999}$. When maximum sensitiveness is desired, the plug is inserted at F, thereby cutting out all shunts and compensators. Removing the plug entirely leaves the circuit open. Inserting it between B and B^1 closes the battery circuit only, and placing it between C and C^1 short circuits the galvanometer with battery left open.

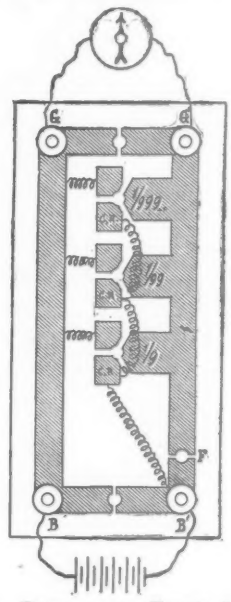


Fig. 1.—Diagram of Frey's Compensating Shunt.

The United States Portelectric Company.

The formation of the United States Portelectric Company of New York, with a capital of $5,000,000, was chronicled in the Electrical Review for December 19. The principal promoters of the company are Ex-Postmaster-General Thomas L. James, John Straiton, of Straiton & Storm, Ex-Judge A. J. Dittenhoefer, C. F. James, Percival Knauth, William James, John T. Williams, Henry Huss, Frank Lawton and Whipple V. Phillips.

The principal object for which the company was formed is the rapid transit of mail matter, especially in New York city. The promoters of the company hope to make it so strong a corporation that inventors with patents and ideas upon the above subject will be attracted, and they may thus in time be enabled to acquire the most desirable inventions for the purpose named.

General Thomas L. James, although his connection with the postal service has not been active for some years, still maintains his interest in everything relating to that subject, and together with some friends he has been engaged in examining into the merits of the Portelectric system, with whose devices the company will start. This system was fully illustrated and described in the Electrical Review for May 30, 1891.

Mr. S. S. Bogart, the general manager of the Electric Secret Service Company, of this city, and formerly electrician for the Baltimore & Ohio Telegraph Company, was retained by General James to submit a report upon the Portelectric system. Mr. Bogart found merit in the device, but was in doubt in regard to the power necessary for the operation of cars. The matter of friction also presented a feature which would have to be thoroughly arranged for. Mr. Bogart's report on the whole was rather favorable to the Portelectric system, and in fact he advised General James that if certain questions could be satisfactorily answered by the inventors the company ought to begin business with not less than ten miles of double track.

Mr. J. J. Carty, the well known electrician of the Metropolitan Telephone and Telegraph Company, was next consulted by General James and his friends. Mr. Carty reported to General James that while the project might have in it elements of ultimate success, he doubted if it was of immediate practical value, and he thought that its development would require the highest grade of financial engineering and executive talent. In spite of this opinion, Mr. Carty seemed to think well of the scheme.

"If anybody could obtain possession of contracts for carrying mails or parcels," Mr. Carty's report concludes, "and could get the necessary capital and the right of way to construct a road between two favorable points, an impetus would be given to the general question of high speed, and it would bring to the company all of the high speed schemes now in a condition more or less moribund."

General James thinks that the structure of the elevated railways in New York city could be utilized for constructing a Portelectric system for carrying the mails from the general post office to the Grand Central station; the idea would be to suspend the apparatus from the structure. It is thought that a car could make such a trip in eight or ten minutes.

Judging from the *personnel* of the promoters of this new company and their sincerity in the matter, which is shown by their employing such eminent experts, it is evident that the company means business. It is said that work will be commenced at once.

The Astoria Electrical Manufacturing Company.

The Astoria Electrical Manufacturing Company has been organized, with a capital of $500,000, for the manufacture and sale of electrical machinery and apparatus, especially stationary and traction motors; and for that purpose has secured the ownership of United States patents issued to Mr. W. M. McDougall and Mr. John Boothby, which embrace improvements perfecting a practical, economical and complete system of car traction, whether operated by overhead, underground or storage battery currents, either high or low tension. They are also adapted to central station motor plants or for mining machinery, and for all methods of transmission of power by electricity.

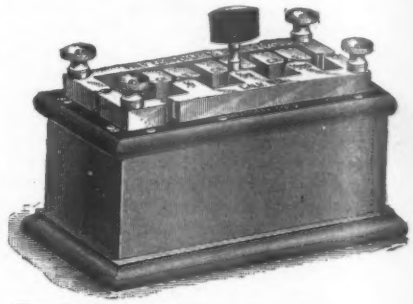


Fig. 2.—Frey's Compensating Shunt Box.

Offices have been taken at 14 Dey street, this city. The officers of the company are as follows: President, Conrad N. Jordan; vice-president, William Steinway; treasurer, Herman Ridder; secretary, Chas. W. Spear; general manager, W. M. McDougall. Directors: William Steinway, Edward Uhl, Egerton R. Burpee, Herman Ridder, Conrad N. Jordan, W. M. McDougall, Chas. W. Spear.

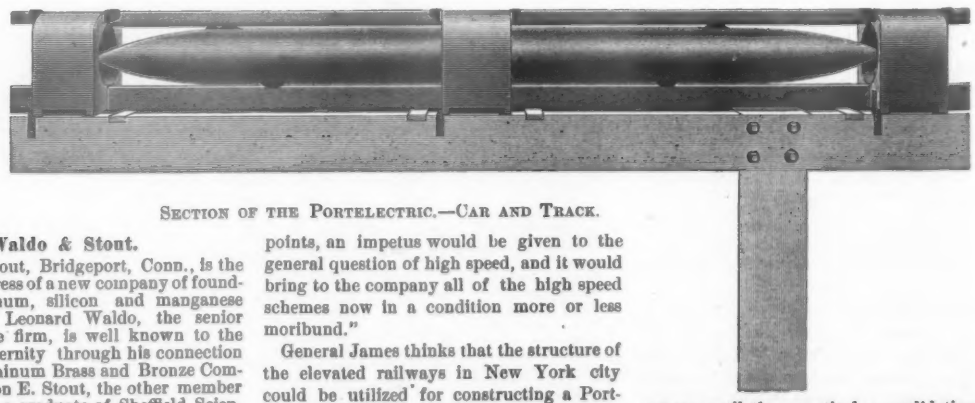
District Telegraph Combination in New York.

Last week a contract was signed for the consolidation of the American District Telegraph Company and the Mutual District Messenger Company. New officers of the Mutual Company were elected and it is said that as soon as present contracts are terminated there will be only one service at increased rates.

The new officers of the Mutual District Company are: President, E. R. Chapman, of the firm of Moore & Schley; vice-president, Horace L. Hotchkiss; secretary, W. W. Ryder; treasurer, A. Blackburne.

All the stock of the Mutual Company has been bought up by people favorable to consolidation. The two companies intend from now on to act in harmony. A better service will be provided for the public and some unnecessary expenses will be cut off. Sooner or later a single set of officers for the two companies, which are now virtually one, may be elected, but this has not yet been determined on.

Gen. T. T. Eckert is president of the American District Telegraph Company. Both sets of officers will have co-ordinate powers until the practical consolidation of the corporations in a single company, in name as well as virtually.



Section of the Portelectric.—Car and Track.

Waldo & Stout.

Waldo & Stout, Bridgeport, Conn., is the name and address of a new company of founders in aluminum, silicon and manganese bronze. Dr. Leonard Waldo, the senior partner of the firm, is well known to the electrical fraternity through his connection with the Aluminum Brass and Bronze Company. Newton E. Stout, the other member of the firm, is a graduate of Sheffield Scientific School and a son of Joseph F. Stout, a well known Wall street banker. Waldo & Stout have commenced the erection of a model plant at Bridgeport, and will soon be in the market with castings of the metals named above.

Henry Villard.

The daily press for a week past has contained many rumors about Mr. Henry Villard, president of the Edison General Electric Company. It was stated that Mr. Villard was to resign, to be succeeded by the Hon. Carl Schurz. These statements were denied by those in authority in the Edison Company.

The Chattanooga, Tenn., Electric Light Company has two new directors, also two new stockholders. They are C. D. Beebe and F. S. Hadley. These gentlemen bought the stock of J. T. Williams and A. Lloyd, and were elected to fill the vacancies in the board of directors caused by these gentlemen's withdrawal. The amount of stock purchased by Messrs. Beebe and Hadley is one-sixth of the capital stock of the company, or nearly $17,000.

On Polyphasal Generators.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, DECEMBER 16, 1891, BY M. I. PUPIN, PH. D., COLUMBIA COLLEGE.

Few will deny the importance of the polyphasal current systems; none the fascination of their study. This belief induced me to present the following brief essay before the Institute:

The experimental researches in this new and promising field of electrotechnics are not yet numerous, but still the results already obtained are of so decisive a character as to leave no doubt whatever as to the extremely high practical importance which is attached to electrical generators, motors and transformers, constructed according to requirements imposed upon us by this new method of combining a set of variable electromotive forces. For who among us does not thoroughly appreciate the beautiful inventions of Nikola Tesla and the completeness of the success which Dobrowolsky and Brown obtained by the practical applications of these inventions?

The exact quantitative relations involved in the polyphasal system of currents are not, I venture to say, quite as well known as its practical results. To give an impulse to further inquiry in that direction is one of the principal aims of this modest investigation. For the present I propose to confine myself to the polyphasal generators in general, and particularly to polyphasal generators whose system of electromotive forces is capable of producing a rotary magnetic field of constant strength. The last point seems to me to be one of the vital points in this new method of electrical distribution. It is in this particular point that Mr. Dobrowolsky claims his system to be superior to that of Nikola Tesla.

Let us consider the theoretically simplest form of a polyphasal generator, as shown in Fig. 1. A non-magnetizable ring with n open equal coils at equal distances from each other rotates uniformly through a perfectly homogeneous magnetic field. Let PP′ be the neutral plane of the field. At the instant when coil 1 is at the angular distance θ from the neutral plane PP′ the electromotive force generated in the various coils will be

$$e_1 = K \sin(\theta + a)$$

$$e_2 = K \sin\left(\theta + a + \frac{2\pi}{n}\right)$$

. . . . . .

. . . . . .

$$e_n = K \sin\left\{\theta + a + (n-1)\frac{2\pi}{n}\right\}$$

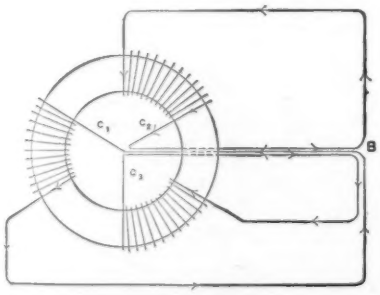


Fig. 3.

Where K is a constant depending, as is well known, on the field intensity, the speed of rotation, the number of turns in the coil and the area of the plane of a turn; a is the angular width of one-half of the coil.

Since

$$\sin(\theta+a)+\sin\left(\theta+a+\frac{2\pi}{n}\right)+\ldots\ldots+\sin\left\{\theta+a+(n-1)\frac{2\pi}{n}\right\}=0$$

it follows that

$$e_1 + e_2 + e_3 + \ldots + e_n = 0 \ldots . (1).$$

That is to say, the sum of electromotive forces generated in the various coils which are on one side of the neutral plane is numerically equal and of opposite sign to that of the coils on the other side of this plane. This result is well known and self-evident. It is, however, far from self-evident that relation (1), which I shall call the *relation of continuity*, for the electromotive forces, will be satisfied by every magnetic field.

Close each coil separately by conductors of equal resistance and self-induction. Let $c_1, c_2, \ldots . c_n$ denote the currents in the n separate circuits. It is evident that

$$c_1 = \frac{K}{I} \sin(\theta + a - \varphi)$$

$$c_2 = \frac{K}{I} \sin\left(\theta + a + \frac{2\pi}{n} - \varphi\right)$$

$$c_n = \frac{K}{I} \sin\left\{\theta + a + (n-1)\frac{2\pi}{n} - \varphi\right\}$$

Where I is the impedance in each circuit and φ the angle of retardation. Hence, we have

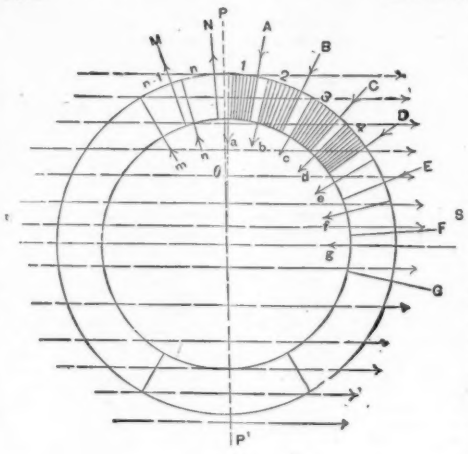


Fig. 1.

$c_1 + c_2 + c_3 + \ldots\ldots + c_n = 0 \ldots . (2)$. That is to say, the relation of continuity is satisfied for the currents also.

Let the wires $aA, bB, \ldots\ldots nN$ (Fig. 2) represent a part of each of the n conductors of this system. Then, according to relation (2), the sum of the currents in these n linear conductors being always zero, if we joined them all into one conductor there would be no current in this wire, but the currents in the n circuits would circulate exactly the same as before. In fact, the common juncture is useless and can and should be cut out.

The diagram, Fig. 3, represents this method of connecting for a three phase system. Consider, now, n equal coils distributed at angular distances of $\frac{2\pi}{n}$ over a laminated iron ring B, each coil being a part of the n conductors coming from the generator. Diagram Fig. 4 illustrates this for a three phase system. Let the n currents be denoted now by $c_1', c_2', \ldots\ldots c_n'$. We shall have, now,

$$c_1' = \frac{K}{I} \sin(\theta + a - \varphi')$$

$$c_2' = \frac{K}{I} \sin\left(\theta + a + \frac{2\pi}{n} - \varphi'\right)$$

$$c_n' = \frac{K}{I} \sin\left\{\Theta + a + (n-1)\frac{2\pi}{n} - \varphi'\right\}$$

and, therefore,

$$c_1' + c_2' + \ldots\ldots + c_n'' = 0 \qquad (3).$$

The introduction of the iron ring with the n coils into the n phasal system has changed the impedance I, and the angle of retardation φ; but this change is evidently the same for all coils. The correctness of this statement might, perhaps, be questioned, if we supposed that the system of the n variable currents was at any moment strong enough to saturate the iron ring; I, therefore, suppose that the intensity of magnetization in the ring is never over 10,000 C. G. S. lines of force. We shall presently see that in the case of a properly built generator the saturation of the iron ring will not vitiate the correctness of the above statement in the slightest.

Let s be the number of turns in each of the n coils. Relation (3) gives $4\pi s c_1' + 4\pi s c_2' + \ldots\ldots + 4\pi s c_n' = o$ (4). Relation (4) translated into physical language means that the magnetization in the iron ring is due to two equal magneto-motive forces working in multiple arc. The magnetic field produced is perfectly symmetrical with respect to the ring as indicated by the dotted lines in Fig. 4.

A simple consideration will show that the field rotates around the axis of the ring B synchronously with the rotation in the generator which produces the impressed electromotive forces. Consider the armature of the generator. Since the ampere turns on one side of the neutral plane is always equal and opposite in sign to the ampere turns on the other side of this plane, it is evident that the magnetic field, due to the ampere turns in the armature, is fixed in space and persectly symmetrical with respect to the plane of symmetry PP[1]. We can, therefore, say that this field, though *fixed in space, rotates with respect to the armature* with the *same angular* velocity with which the armature rotates in space. The distribution of the ampere turns over the stationary ring B being at any moment the same as that over the armature ring, it follows that the magnetic field of B also rotates, with respect to B, synchronously with the rotation in the armature. An inspection of the diagram in Fig. 4 will show that when the rotation in the generator is reversed the rotation of the field B will also be reversed.

The strength of the rotating magnetic field will vary in strength, because the strength of the two equal magneto-motive forces which are working in multiple arc will vary. The following simple consideration will show us the law of this variation. Two cases must be considered separately. First, when n is an odd number; secondly, when n is an even number.

Case 1.

A simple definition will save me the tedious repetitions of long sentences. I define the sum of all the electromotive forces generated in all the turns which are at any moment on the same side of the neutral plane of the generator as the resultant impressed electromotive force at that moment. The magneto motive force of the rotating field will evidently vary according to the same law as the resultant impressed electromotive force. To find the law of variation of the resultant impressed electromotive force, consider the armature of the generator when the angle Θ of coil 1 is zero. To make the reasoning shorter, I make now the angular width of each coil equal to $\frac{2\pi}{n}$, so that the n coils completely cover the ring, which makes $a = \frac{\pi}{n}$. If this angular width is smaller, then a simple consideration will show that this law of variation which I am about to deduce will be exactly the same. In the position just mentioned, the coils 1, 2, 3, ... $\frac{n-1}{2}$ will all be on the same side of the neutral plane, whereas coil $\frac{n+1}{2}$ will be just half on one side and half on the other side of this plane. There is no electromotive force generated in this coil. As the above mentioned angle Θ begins to increase from zero, coil $\frac{n+1}{2}$ begins to contribute to the resultant impressed electromotive force, but this contribution is just counterbalanced by the loss due to the entrance of coil n into the opposite region of the neutral plane. The variation in the resultant impressed electromotive force is, therefore, due solely to the change of position of the turns in the coils 1, 2, 3, ... $\frac{n-1}{2}$, or on one side and the corresponding turns on the other side of the neutral plane. This will be the case until coil $\frac{n-1}{2}$ has

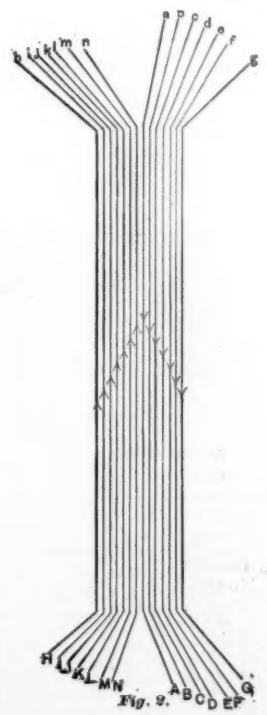


Fig. 2.

(Continued on page 252.)

—— A plant for making fuse wire will be established at Xenia, Ohio.

—— The Thomson-Houston Carbon Company wants $20,000 bonus to rebuild at Fremont, Ohio.

—— Edward T. Steel & Company will install two 600 light Thomson-Houston dynamos in their new cloth mills at Bristol, Pa.

—— As the city council and the electric light company, of Petersburg, Ill., cannot agree on terms, the city will be in darkness for awhile.

—— The Edison General Electric Company has secured the contract for furnishing and installing the electrical equipment of the new United States cruiser "New York."

—— The directors of the Thomson-Houston Electric Company have declared a semi-annual dividend of 3½ per cent. on the preferred stock, payable January 1, to stock of December 22.

—— H. Ward Leonard & Company have secured the contract for wiring the *Mail and Express* Building for 3,500 incandescent lamps, acting as sub-contractors under the Waddell-Entz Electric Company.

—— The Rutland, Vt., Electric Light Company have started another 50 light arc dynamo, two incandescent dynamos, and another 75 horse-power generator. This gives them 300 arcs, 1,200 incandescents and 100 horse-power for motors, requiring three engines and making this plant the largest in the State.

—— Director Windrim has received from Chief Walker, of the Philadelphia Electrical Bureau, a report on the bids for the city electric lighting for 1892, naming the successful bidders in the various districts. The aggregate of the bids is $268,800, or $2,800 more than is in the appropriation bill for lighting.

—— Judge McClung handed down an opinion last week ordering the Wilkinsburg, Pa., Electric Company to give Edgewood borough cheaper light. The plaintiff alleged that a contract had been made with the defendant company for light at a rate as low as that paid by any other borough. The light company stated that 23 cents per lamp was the minimum paid by any of the other boroughs, but the borough officials learned that Brushton was supplied for 18 cents. Judge McClung ordered the rate to be reduced to the same figure.

—— Suit was entered last week by the Western Electric Company, of Illinois, against Charles L. Davis, of the Alvin Theatre, Pittsburgh. The amount claimed is $13,060 for electric equipment supplied to the theatre. In consequence of the suit rumors of serious financial embarrassment at the Alvin are numerous. These troubles are said to have been prime factors in bringing about the serious illness of Mr. Davis. Manager Hyde, of the Alvin, stated that the bill and all other indebtedness of the theatre were fully secured and would be paid.

—— The Minneapolis Brush Electric Company has addressed a communication to Building Inspector Hazen, informing him that on December 5 its first underground cable wires were put in operation, and have been in working order ever since, with the most satisfactory results, not a hitch being reported in the work. The open weather of the past week has wonderfully facilitated the work, and instead of getting in a new circuit each week, as was at first reported, the Standard Underground Cable Company has been enabled to get a new one to work about every two days. If the weather continues fairly good, the cable company will turn over to the Brush Electric Company a complete system by the last of the year.

ON POLYPHASAL GENERATORS.

(*Continued from page 251.*)

completely passed to one side of the neutral plane and coil n is just bisected by it. During this interval Θ has increased from zero to one-half $\frac{2\pi}{n} = \frac{\pi}{n}$. The value of the resultant impressed electromotive force at any moment during this interval is easily found. Denote it by E, then

$$E = e_1 + e_2 + \ldots . e_{\frac{n-1}{2}}$$

$$= K\left\{ \sin\left(\theta + \frac{\pi}{n}\right) + \sin\left(\theta + \frac{\pi}{n} + \frac{2\pi}{n}\right) + \right.$$

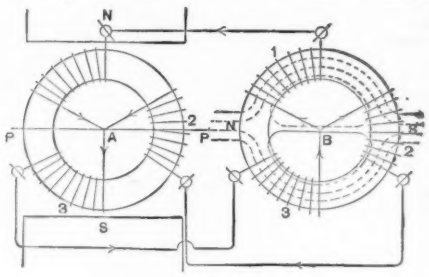


Fig. 4.

$$\left. \ldots . + \sin\left\{\theta + \frac{\pi}{n} + \left[\frac{(n-1)}{2} - 1\right]\frac{2\pi}{n}\right\}\right\}$$

$$= K\left\{ \sin\left(\theta + \frac{\pi}{n}\right) + \sin\left(\theta + \frac{\pi}{n} + \frac{2\pi}{n}\right) + \right.$$

$$\left. \ldots . + \sin\left\{\theta + \frac{\pi}{n} + \left[\frac{n-3}{2}\right]\frac{2\pi}{n}\right\}\right\}$$

$$= \left[\frac{K_1 \sin\left(\theta + \frac{\pi}{n} + \frac{n-3}{4}\frac{2\pi}{n}\right)}{\sin\frac{\pi}{n}}\right] = K_2$$

$$\sin\left\{\frac{\pi}{n} + \theta - \frac{\pi}{2n}\right)$$

$$= K_2 \cos\left(\theta - \frac{\pi}{2n}\right)$$

It is evident that the resultant impressed electromotive force E varies during the interval from $\Theta = 0$ to $\Theta = \frac{\pi}{n}$ just like $\cos\left(\Theta - \frac{\pi}{2n}\right)$; that is to say, it varies just like a simple harmonic. When $\Theta = \frac{\pi}{n}$, E reaches a maximum which is equal to K_2, it has a minimum both when $\Theta = 0$ and when $\Theta = \frac{\pi}{n}$, each of these minima equals $K_2 \cos\frac{\pi}{2n}$. The ratio of the minimum to the maximum value equals $\cos\frac{\pi}{2n}$. For a three-phase system this ratio is .866, and it diminishes very rapidly as n increases. It is evident that after Θ has reached the value $\frac{\pi}{n}$ the armature is, as far as concerns the resultant impressed electromotive force, in exactly the same position as at the start, when $\Theta = 0$. We conclude, therefore, that E has $2n$ equal maxima and $2n$ equal minima during each revolution of the armature. In diagram Fig. 5 these fluctuations of E for a three phase system are represented graphically.

Case 2.

The same relations hold good when n is even. The maxima take place when $\Theta = 0, \frac{2\pi}{n}, \frac{4\pi}{n}, \ldots\ldots$ The minima when $\Theta = \frac{\pi}{n}, \frac{3\pi}{n}, \frac{5\pi}{n}, \ldots\ldots$ and the ratio of any minimum to any maximum is $\cos\frac{\pi}{n}$. Since the magneto-motive force varies according to the same law as the resultant impressed electromotive force, it follows that the strength of the rotary magnetic field fluctuates periodically, having $2n$ equal maxima and $2n$ equal minima during each revolution and the ratio of any minimum to any maximum equals $\cos\frac{\pi}{n}$. That is, when n is odd; but when n is even then there are only n maxima and n minima, and the ratio of any minimum equals $\cos\frac{\pi}{n}$.

A polyphasal generator of this kind would produce a rotary magnetic field of constant strength only when $n = \infty$. For a three phase system the maximum variation would be nearly 14 per cent. of the maximum value. This agrees perfectly with Mr. Dobrowolsky's calculations, but I fail to see how these calculations could justify any one to assume that they hold good for all types of polyphasal generators.* The generator which we have considered could be actually constructed, but its output would be so small in proportion to its size that we may dismiss it at once as an impracticable machine. We can make it practicable by substituting for the non-magnetizable ring which carries the armature coils a laminated iron ring and for the uniform magnetic field the magnetic field of a well made field magnet, with its pole-pieces placed, with respect to the armature coils, in any one of the various ways sanctioned by practical experience. But, in a generator of this kind, the resultant impressed electromotive force will no longer vary, according to the law which I have pointed out a little while ago. To be sure, we shall still have the same number of maxima and minima, as may be inferred readily from our knowledge of the shape of the electromotive force curve of a continuous current dynamo. We all know that this curve is not in general a straight line, but a wave line having as many maxima and as many minima as there are sections on the commutator. But the ratio of the maxima to the minima is no longer an *a priori* calculable quantity. If we knew the mathematical relation between the intensity of the field at any point of the armature surface and the co-ordinates of this point with respect to the neutral plane, then we could calculate that ratio. A much easier and practically much more important problem is to determine the conditions which must be fulfilled in the construction of a polyphasal generator, in order that it may be capable of producing a rotary magnetic field of constant intensity in the simplest possible way, that is, without the application of brushes and commutators. Mr. von Dolivo-Dobrowolsky seems to think that a three phasal generator is incapable of doing that, for he distinctly says that such a generator necessarily produces a rotary magnetic field whose strength varies 14 per cent. He also states that (evidently to obviate these fluctuations) the Allgemeine Electricitats Gesellschaft employ a method of transmitting currents of smaller differences of phase than one-third of the period through three wires. In this point they claim to be ahead of Tesla, Bradley, Haselwander and Wenstrom. In fact, if one is not exceedingly careful in the perusal of Dobrowolsky's discussions of this subject he will be led to believe that the rotary field in some of Tesla's motors varied as much as 40 per cent. and certainly not less than 14 per cent. I do not think that Mr. Dobrowolsky wishes to be understood as holding that opinion; for neither he nor anybody else, excepting Tesla himself, can know what these variations were. The number of phases employed tells us nothing definite about the range of these variations.

A polyphasal dynamo which is capable of producing a rotary magnetic field of constant intensity must be constructed in such a way that its resultant impressed electromotive force must remain constant as long as speed and the magnetic field of the field magnets remain constant. As long as the variable electromotive force developed in each coil follows the law of a simple harmonic that result can never be accomplished by a finite number of phases, but it may, perhaps, be accomplished by producing in each coil a variable electromotive force which varies according to some definite complex harmonic law. In a well made commercial machine the electromotive forces developed in the various turns of the armature always vary according to some such a law. The form of this complex harmonic law depends on the form of the magnetic field of the field magnets and also on the distribution of the coils over the armature. The problem that remains to be investigated consists, therefore, of three parts: 1st. What must be the particular form of the complex harmonic electromotive force developed in each coil of a polyphasal generator, in order that both the condition of continuity be fulfilled and also that the resultant impressed electromotive force be continually constant. 2d. What form of the magnetic field of the field magnets will be capable of producing such an electromotive force. 3d. Can a continually constant resultant electromotive force produce a rotary field of constant strength.

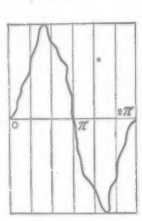


Fig. 6.

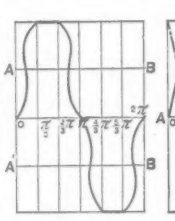


Fig. 7.

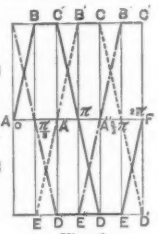


Fig. 8.

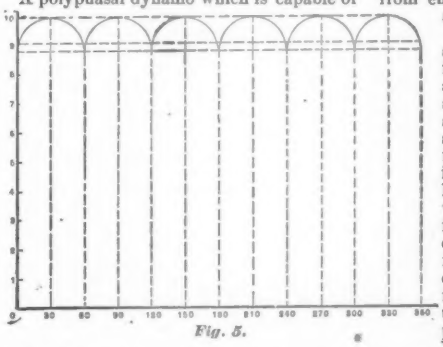


Fig. 5.

1st. The first part of this problem is purely mathematical. In a paper read before the New York Mathematical Society I indicated a method of discussing this part in a general way, and worked out completely two particular cases, namely the cases of a three and four phasal system. The paper is given in the appendix.

2d. For a three phasal system the form of the complex harmonic electromotive force given in Fig. 7 will satisfy all the conditions. The form A, B, C, E, F, given in Fig. 8, is only a particular case and ought to be aimed at in the construction of the machine. When there are only three turns within a space through which the armature moves with respect to the field during the time that corresponds to a complete period, as in the case of the Lauffen generator (see Figs. 11 and 12), then the field of the field magnets must be constant in intensity during an angle which corresponds to one-sixth of the period. I have indicated that in the diagram, Fig. 9. In the case of bipolar three phasal generators, as indicated in the diagram, Fig. 10, where we have six coils, the diametrically opposite pairs being connected in series; the pole faces must have an angular width of 120 degrees and the field must be constant in intensity within the region bounded at any moment by the armature and the pole faces. This is a practical problem offering no serious difficulties, judging from the experimental results obtained by S. Thompson, Isenbeck, Mordey and others, and also from the experimental results obtained lately by a graduate of our school, Mr. Freedman, John Tyndall Fellow of Columbia College.

The curve of impressed electromotive force which must be produced in the case of a four phasal generator is given in Fig. 13, and needs no further commentary. Larger number of phases offer no special advantages, whereas the disadvantages arising from employing a large number of phases are self-evident.

3d. When a coil in which a simple harmonic electromotive force is developed is closed by a resistance, whether self-inductive or non-self-inductive, the current which is set up in the closed circuit will be a simple harmonic, having, therefore, all the characteristics of the impressed electromotive force. This, however, is not necessarily the case when the impressed electromotive force is a complex harmonic. A complex harmonic electromotive force is composed of a large number of simple harmonic electromotive forces of different frequencies, all the higher frequencies being multiples of the fundamental frequency. When, therefore, a coil in which a complex electromotive force is generated is closed by a conductor, and the current is started, the current will be also a complex harmonic, each simple harmonic component of the complex harmonic electromotive force producing its own simple harmonic current, which is a component of the resultant complex harmonic current. But since the component simple harmonic electromotive forces have each a different frequency, it follows that they will have a different impedance and the shifting of phase will be also different for each component current, currents of higher frequency having a larger shifting in phase and also the ratio of the amplitude of any one of the component currents to the amplitude of any other component of lower frequency, being smaller than the ratio of the amplitudes of the corresponding component electromotive forces. In this respect the propagation of the complex harmonic current-wave resembles very much the propagation of a complex harmonic sound-wave or a complex harmonic light-wave through an absorptive medium like air. The component simple harmonic waves of light and sound will in general suffer the less through the transmission the longer their wave-length. Just as the sound and light-waves, after such a transmission, lose a great many characteristics of the original vibration which produced them, so an electric wave in its transmission through a conductor possessing ohmic resistance and electro-magnetic, not to speak of the electro-static, inductance will lose a great many characteristics of the impressed electromotive force.

To put this into simple symbolic language of mathematics,

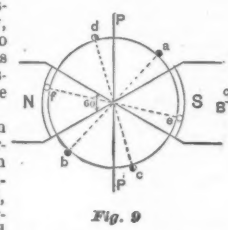


Fig. 9

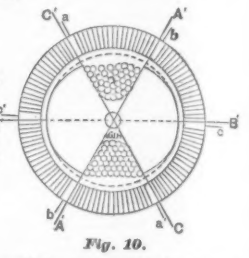


Fig. 10.

Let L be the coefficient of self-induction of the circuit,

Let R be the total resistance,

Let $K\sum_1^\infty {}_m a_m \sin m\,p\,t$ be the complex harmonic impressed electromotive force where $p = 2\pi \times$ fundamental frequency,

Let x be the value of the current at any moment t,

We shall have, then,

$$L\frac{dx}{dt} + Rx = K\sum_1^\infty {}_m a_m \sin m\,p\,t.$$

The solution of this differential equation gives

$$x = K\sum_1^\infty {}_m \frac{a_m}{\sqrt{R^2 + m^2 p^2 L^2}} \sin(m\,p\,t - \varphi_m) \text{ where } \tan\varphi_m = \frac{m\,p\,L}{R}$$

The current x is a complex harmonic, its component simple harmonic currents being $x = x_1 + x_2 + \ldots . + x_m + \ldots . \; ad\; infin.$

The current $x_\alpha = \frac{K a_\alpha}{\sqrt{R^2 + a^2 p^2 L^2}} \sin(a\,p\,t - \varphi_\alpha)$ tan $\varphi_\alpha = \frac{a\,p\,L}{R}$

Let E be the impressed electromotive force, then $E = e_1 + e_2 + e_3 + \ldots \ldots + e_m + \ldots\ldots \; ad\; infin.$

The component simple harmonic electromotive force e_α is given by

$$e_\alpha = a_\alpha \sin a\,p\,t$$

These relations give an exact quantitative expression to the preceding physical description.

These considerations made me hesitate at first in taking as granted that a polyphasal generator producing complex electromotive forces, such as I deduced mathematically in the course of my paper, would be capable of producing a rotary magnetic field of constant intensity. But I was glad to find out that my hesitation was groundless.

Consider the three-phasal generator whose diagram is given in Fig. 10. Take, now, another *well-laminated* armature wound in a similar way as the armature of the generator. Connect the three pairs of coils of the generator to the three sets of coils in armature 2. We shall have three separate circuits, the ohmic resistance and the self and mutual inductance in each circuit being the same. Denote by E_1 E_2 E_3 the three complex harmonic electromotive forces in the three circuits. Let x, y, z be the currents at any moment. Then we shall have

$$L\frac{dx}{dt} + M\frac{dy}{dt} + M\frac{dz}{dt} + Rx = E_1$$

$$L\frac{dy}{dt} + M\frac{dx}{dt} + M\frac{dz}{dt} + Ry = E_2$$

$$L\frac{dz}{dt} + M\frac{dx}{dt} + M\frac{dy}{dt} + Rz = E_3$$

But since $E_1 + E_2 + E_3 = 0$ for all values of t, it follows that

$$L\frac{d}{dt}(x+y+z) + 2M\frac{d}{dt}(x+y+z) + R(x+y+z) = 0$$ for all values of t. This can be true only if

$$x + y + z = 0$$

for all values of t. That is to say, the currents fulfill the condition of continuity. We

*M. v. Dolivo-Dobrowolsky: Der Drehstrom und seine Entwickelung; Officielle Austellungs Zeitung Electricitats, Heft 12.

can, therefore, employ the method of polyphasal connection. Substitute now in the first of the three differential equations

$$z = -(x + y)$$

and we obtain

$$(L - M)\frac{dx}{dt} + Rx = E_1 = K\sum_1^\infty{}_m\, a_m \sin m\,p\,t$$

The solution of this equation gives

$$x = K\sum_1^\infty{}_m \frac{a_m}{\sqrt{R^2 + m^2\,p^2\,(L-M)^2}} \sin (m\,p\,t - \varphi_m)$$

Similarly

$$y = K\sum_1^\infty{}_m \frac{a_m}{\sqrt{R^2 + m^2\,p^2\,(L-M)^2}} \sin \left\{m\,(pt = \frac{2\pi}{3}) - \varphi_m\right\}$$

$$z = K\sum_1^\infty{}_m \frac{a_m}{\sqrt{R^2 + m^2\,p^2\,(L-M)^2}} \sin \left\{m\,(pt + \frac{4\pi}{3})\,\varphi_m\right\}$$

But L is very nearly equal to M_1; in fact, both are pretty small when the metallic parts of the magnetic circuits are near the saturation point, so that $L - M$ is exceedingly small, and $m^2\,p^2\,(L-M)^2$ will be very small in comparison to R^2, even for large values of m, unless the frequency is very high. Also, since

$$\tan \varphi_m = \frac{m\,p\,(L-M)}{R}$$

φ_m is exceedingly small unless p is very large, we shall have for moderate frequency generators

$$x = \frac{K}{R}\sum_1^\infty{}_m\, a_m \sin m\,p\,t$$

and similarly for y and z. The same method of reasoning may be easily applied to any number of phases. The mathematical operations will be considerably larger, but still the same results will be deduced without much difficulty.

That is to say, the curves for the currents are the same complex harmonics as those of the impressed electromotive force. The currents, therefore, produce a rotary magnetic field of constant intensity; this is evidently true even if these currents produce a saturation in the iron part of the magnetic circuits.

The resemblance between a polyphasal generator and a continuous current dynamo, which these relations bring into view, is exceedingly striking and instructive.

The advantages gained from a polyphasal generator capable of producing a rotary magnetic field of constant intensity, would be very much diminished, indeed, if it should turn out that it is impossible to devise a simple and efficient method of transformation by means of which the polyphasal system of currents producing a rotary field of constant intensity (a constant rotary field system) can be transformed any number of times without losing its distinguishing characteristic. I intended to discuss this problem also, this evening, but having been disappointed by the mechanician who is constructing several pieces of apparatus illustrating this problem, I decided to postpone this discussion to some other time.

High Buildings—High Premiums.

The Chicago Board of Fire Underwriters has adopted a $3.50 rate on all buildings over eight stories high. The regular rate is 90 cents. It is understood that this policy has been adopted in order to restrict the erection of "sky-scrapers."

Lectures on Electricity.

Professor L. I. Blake, of the University of Kansas, Lawrence, Kas., is giving a course of 12 lectures upon the plan of university extension which the State University of Kansas is carrying out quite extensively in Kansas City, Topeka and other neighboring cities. For instance, these lectures are given every two weeks before a class of about 150 citizens of Topeka, including judges of the Supreme court, lawyers, physicians, merchants and a number of practical electricians.

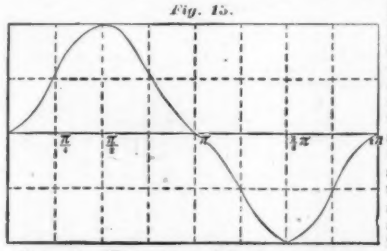
The titles of some of Prof. Blake's lectures are: "The Electric current, its Elements;" "Electro-Dynamics of the Current;" "Electromagnetic Induction," etc.

These lectures are very interesting and valuable as presented by Professor Blake, who is a progressive scientist of rare ability. The wide interest they have attracted in this Western State is an evidence of the great demand for electrical knowledge, and also an evidence of the progressive nature of the citizens of Kansas.

Five Messenger Boys.

The story of five messenger boys begins in the early days of telegraphy, says the New York *Sun*. In a dingy office in Pittsburgh about 1848, Andrew Carnegie, Henry W. Oliver, Robert Pitcairn, Major William C. Moreland and David McCargo, were messengers. It is said that they took the opposite of other boys, and spent their spare moments in learning useful lessons. Andrew Carnegie is the oldest of the lot, and he was smartest, leading all in learning how to

Fig. 15.



telegraph. He was one of the first operators in the country to learn to take the Morse system by sound, which in those days was considered a remarkable achievement. It did not take Thomas A. Scott long to snatch Mr. Carnegie from the telegraph office in Pittsburgh into his office as private secretary, when the great railroad genius took charge of the Pittsburgh end of the road. The education the young Scotchman received from a greater mind lifted him from a secretary's seat into the place of division superintendent when Mr. Scott was made vice-president of the railroad. The industry, the subtle cunning and watching faith of Scott taught him to lay his lines in other directions than watching the divisions of a railroad, and Scott helped him. His place gave him the opportunity to look into other lines of industry, and he drove a drift into an iron mill. His pickaxe was not large, but his cunning and thrift made up for the size of his axe. J. Edgar Thompson, who was the President of the Pennsylvania Railroad, then gave a great name and money to the works now dominated by Mr. Carnegie. At that time Col. Scott was a power in the nation, as well as the railroad, and Carnegie began to gather wealth.

"My ambition in those days," he said, recently, "was to write for newspapers. I took in material in that direction whenever it was possible. I haunted the public library in Allegheny, and caught on to the fact that a distinction was made by the attendants between the poor boys and the sons of well to-do parents. It made me indignant. I wrote my first public letter to the Board of Control, and a change was ordered. This result more than ever resolved me to follow journalism, but an accident drifted me elsewhere, and I became a manufacturer."

Thrift and industry were the derricks which lifted Harry W. Oliver out of the telegraph chair next to Mr. Carnegie, and made him a clerk for a big iron firm. He is an Irishman, with a head full of cunning about the business economies of life. It did not take long for him to realize the possibilities of the iron trade, and one day a slick working block and tackle hoisted him out of his seat at the desk in the big firm's workshop and landed him in a business that has since grown to be one of the greatest concerns in the world. He has grown very rich, and one railroad and seven manufacturing concerns now feel the touch of his hand. He lives in the finest house in the West, but he works too hard to enjoy himself. He must be about 55 years of age, and a few notches lower than Mr. Carnegie in the scale of years. He once came near being United States Senator. He was the brains of the Tariff Commission which, Senator Sherman says, framed the best and fairest bill ever presented to Congress.

Another Scotchman of the famous five is Robert Pitcairn, who sits in the seat once occupied by Col. Tom Scott and Mr. Carnegie. He went from a telegraph chair into the railroad business, and he has been a master in all the best conditions of railroad life. He is many times a millionaire, but he lives for his railroad, although interested, like Mr. Oliver, in many large manufacturing enterprises. He does the work of about three men every day, and takes recreation only when he wants to talk with a big friend or indulge with his countrymen in the melodies of Scotland. He has denied himself promotion many times because he likes to cling to the location where he began as a messenger boy and has had so many triumphs.

The fourth member of the group is David McCargo, the general manager of the Allegheny Railroad. His strong Scotch character lifted him into big railway concerns early. He left the telegraph office soon after the other boys and took a place on the railway.

"Think of it," said Major William P. Moreland, the last, but not least, of the famous five, "I stood at the key with Carnegie, Oliver, Pitcairn, McCargo, and heard the first message pass over the wires that was sent between the North and South. James D. Reid, who was general superintendent; David Brooks, now living in Philadelphia, and Jackson Duncan, of Cincinnati, had charge of the experiment. We had to work on short circuits in those days, and we thought it was impossible to send a message to New York from New Orleans. Brooks and Reid walked over and inspected the line from the Crescent City to Pittsburgh. After arriving here and assuring themselves that the line was perfect, the effort was ordered and every telegraph operator on the line, and, in fact, the whole country, was waiting in suspense to know the success or failure of the effort. Every magnet was adjusted, and every electrician on the line stood at his key listening for the result. At the signal, New York called Philadelphia, the Quaker City signaled Harrisburg, and then, in quick succession, Pittsburgh, Cincinnati, Louisville and New Orleans, were opened to the metropolis. No one drew a breath scarcely until the tick came, and in a minute an unbroken message was sent between the North and South. That may seem primitive in these days, when there is no measuring electric power, but then it was the talk of the nation. This is a bit of untold history; but I shall never forget that hour.

"Mr. Carnegie never forgets the old boys, and we shall never forget celebrating his twenty-first birthday. He was Scott's confidential clerk then, and he invited his former companions in the telegraph office to his

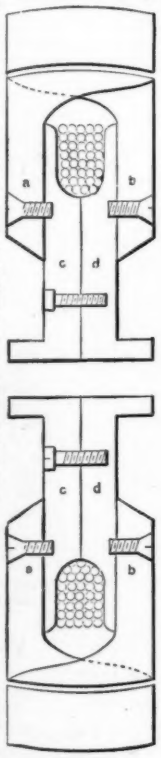


Fig. 11.

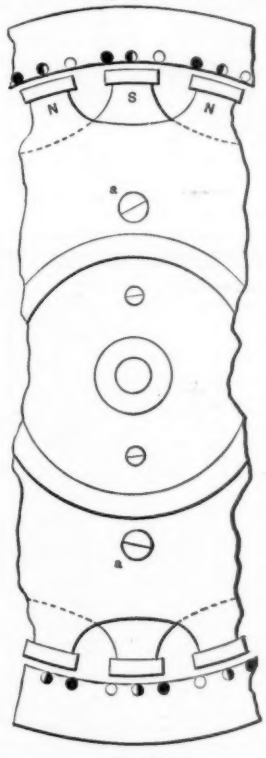


Fig. 12.

home in Allegheny, where his mother and brother lived. We had a good time, and parted with mutual wishes for each other's success. I think there are no regrets among us, except that we cannot live always."

Phonographs for the Deaf.

Superintendent Johnson, of the Deaf and Dumb Institute, at Indianapolis, Ind., has been making some interesting experiments with the phonograph, and believes that in connection with it he can teach the majority of the deaf mutes under his charge to talk. He finds that the instrument concentrates the sound at the drum of the ear in such a way that many of the pupils, otherwise deaf, are enabled to hear.

He tried the phonograph with 27 boys and 29 girls. Of these only three girls were unable to hear anything at all. Twenty boys and 20 girls could hear instrumental music, while 11 boys and 15 girls could distinguish spoken words.

Of the 56 whose hearing was tested by placing the phonograph tubes in their ears, 28 could hear best with the left ear and 14 with the right, while 11 heard alike with both.

Suits Against Telegraph Lines.

The annual report of Attorney-General Miller was submitted to Congress December 10. He devotes a chapter to the new Circuit Court of Appeals, which, he says, has been organized in each circuit and is ready for business, although the additional circuit judge in each circuit has not yet been appointed. It was found that the court could be organized and such business as might be offered could be transacted without such judges, so their appointment was delayed until such appointments could be acted upon by the Senate.

It is necessary, he says, that some provision be made for the care of the business of the government in the Circuit Court of Appeals. In each circuit there are several districts, and, of course, government cases will be carried by writ of error or appeal from each of such districts into the Circuit Court of Appeals. The law as it stands authorizes and requires no one to appear for the government in such court. He suggests that each district attorney be required to follow and care for the cases from his district in the Court of Appeals.

The Attorney-General reports that five suits have been commenced under the Act of August 7, 1888, requiring all telegraph lines subsidized by the government, by and through their own respective corporate officers and employés, to maintain and operate for railroad, governmental, commercial and all other purposes, such telegraph lines, and requiring the Attorney-General by proper proceedings, to prevent any unlawful interference with the rights and equities of the United States in relation to such telegraph lines. On this subject the Attorney-General says:

"The suits of the United States against the Central Pacific Railroad Company and the Western Union Telegraph Company, and against the Southern Pacific Railroad Company and the Western Union Telegraph Company, both pending in the Northern District of California, are pending on demurrers and motions to dismiss for want of jurisdiction, it being claimed on behalf of the Western Union Telegraph Company and other corporations necessary parties defendant, having charters from other States than California, that they cannot be sued in the United States Circuit Court in any district in a State other than that from which they derive their respective charters. In other words, that they are not inhabitants of any district except a district in the State by which they were created.

"The result of such contention is that a corporation like the Western Union Telegraph Company, a New York corporation, which is doing business in every State and district in the Union, which has the right to sue in the federal courts of the various districts, and if sued in the State courts to remove such suits for litigation in the federal courts, cannot be sued in the federal courts in any State outside of New York. A natural person, being a citizen of New York, under the statute, might be sued in California by a citizen of California, although he might be simply sojourning in that district; but this corporation, which really has a domicile in every district in the Union, can only be sued in the State of New York. It is not believed that such is the law, at least, where the government is plaintiff. Certainly it was not the intention of Congress, in enacting the judiciary law of 1888, to thus make corporations a privileged class. Under this construction an alien corporation—that is, a corporation of Great Britain or any foreign nation—could not be sued in the federal courts in this country at all.

"I recommend that Section 1 of the Act of August 13, 1888 (25 Stat., p. 434), be amended by inserting the proviso, in italics, after the word 'inhabitant' in the following sentence, namely:

"And no civil suit shall be brought before either of said courts against any person by any original process or proceeding in any other district than that whereof he is an inhabitant;

"*Provided*, That any foreign corporation may be sued in any district where it may be found, process to be served as in like cases in the State where said suit or action is brought.

"Such an amendment would restore the law to what it was for a century prior to the Act of March 3, 1887, and would impose on these corporations a liability to be sued corresponding to the right they enjoy to sue as plaintiffs, and to remove suits in which they are defendants."

Last week the Chicago Electric Wire Company began manufacturing wire at the Wilmington, Del., plant of the defunct Cobb Vulcanite Wire Company. It is said that the new company already has several large orders in hand.

KINDRED INTERESTS

Aug. Hummler, 233 Penn avenue, Scranton, Pa., has a model repair shop for electrical work. Mr. Hummler is also agent for the Billberg motors and dynamos.

Mr. John A. Barrett, electrical engineer and expert, well-known as the inventor of the Barrett chloride of silver battery, has taken an office at 13 Park Row, New York city.

The Electric Improvement Manufacturing Company, temporarily located at 442 Boston Block, Minneapolis, Minn., has purchased the exclusive right to manufacture and sell in the United States J. B. Moore's perfection desk clamp for incandescent lamps. Mr. J. B. Wheatley, of the new company, informs us that they are prepared to fill orders for the usual quality of goods at the old prices.

The Electric Construction and Supply Company, 18 Cortlandt street, New York, report that the new Ward focusing lamp is meeting with great success. Six of these lamps have just been installed for H. C. Jones & Company, photo-engravers, New York. The Hartford Cycle Company, Hartford, Conn., is about to install a 400 light incandescent plant. Fourteen Ward arc lamps have been specified.

The Central Electric Company, Chicago, has just received a large importation of all steel pliers of standard sizes. These goods are guaranteed to be all steel and superior to any on the market, and are being offered at very attractive prices. The company has also received, direct from Germany, an importation of sal-ammoniac, which is guaranteed to be the pure article, and on which they make low prices on large quantity orders.

H. Ward Leonard is licensing various manufacturing and construction concerns under his recently patented system of motor regulation. The basis of the license is a charge of $2.50 per kilowatt (roughly, per horse-power) in the motor. The royalty charge is not an annual charge, but is paid once for all in each case. Wm. Sellers & Company have taken a license under Mr. Leonard's patent on this basis, they agreeing to use the method upon all electric cranes they build in the future, during the life of the patent. The royalty is so small that the method will, no doubt, be rapidly introduced wherever it is applicable.

A. B. C.

Alexander, Barney & Chapin report business very brisk this season, and their formerly crowded establishment has been made more light and pleasant by the additions just completed on the Cortlandt street side of the store. We understand that the new part of their store is to be devoted exclusively to bell hangers' supplies, a catalogue of which has been issued by that enterprising firm. The A. B. C. Company sell everything in the electrical line, including books of instruction, which are very much in demand at present for Christmas gifts. They also have numerous electrical appliances suitable for boys, such as learners' telegraph instruments, toy motors, batteries, etc., and the people passing through Cortlandt street are attracted to the store by the beautiful Christmas tree, illuminated with small incandescent lamps of various colors, which is now shown in their window.

WANTED—The address of manufactories who will make light electric motors of special design for experimental purposes.

ADDRESS,
WM. S. HULL,
SHEFFIELD, ALA.

THE G. H. OBER CO.,
Manufacturers of
TROLLEY POLES,
Pike Poles, Handles, etc.
Chagrin Falls, O.

FOR SALE!
DYNAMOS AND LAMPS.

A number of 15 and 30 light Jenney Dynamos with lamps, price, respectively, $400 and $600. Also four Buckeye Engines, cylinder 15x18, fly-wheel 19 feet by 16 inches face. Disk cranks and automatic cut-offs. Price, $1,000 each, F. O. B. Cars, New Orleans. For particulars, apply to Louisiana Electric Light Company, 52 Union street, New Orleans, La.

THE F. E. BELDEN MICA MINING CO.,
MINERS AND DEALERS IN
MICA.

The Mica of this Company has been put to severe tests and has proved equal in every respect to the best foreign mica, and is for sale at less price.

Office, 28 SCHOOL ST.,
Room 41. BOSTON, MASS.
F. EUGENE BELDEN, Treas.

PATENTED 1891.

"A BIG HIT!"
AN ADJUSTABLE HAMMER
WE CLAIM
this is the Best, Cheapest, Loudest Ringing and Handsomest Electric Bell in the United States.
WRITE FOR PRICES.
G. E. HORN & CO.,
(SUCCESSORS TO HAY-HORN MFG. CO.)
63 South Canal Street,
New Catalogue Ready. CHICAGO.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 56 in. x 18 ft.; 72 in. x 20 ft.; 108 in. x 22 ft. Fox Lathes, 18 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.
Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 72 in. x 60 in. x 15 ft.; 72 in. x 60 in. x 20 ft.
Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.
Crank Shapers, 6 in., 8 in., 10 in., 12 in., 15 in., 16 in., 20 in., 24 in., 28 in.
Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.
Screw Machines, Nos. 5, 6, 7, 8, Power Feed.
Presses, Nos. 51, 52, 53, Ferracute, Nos. 1, 2, 3, Stiles & Parker.
5 Lincoln Pattern Millers, No. 2.
Hand Millers, Nos. 1 and 2. 3 Cam Cutters.
Bolt Cutters, ¼ in. to 1 in., ½ in. to 2 in.
2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.
C. D. and E. Horizontal Boring Machine. Newark Machine Tool Co.
Send for List of New and Second Hand Machinery in Stock.
PRENTISS TOOL & SUPPLY CO., P. O. Box 3362, 115 Liberty Street, New York.

THE LAW
Double Cylinder Battery

Surface of negative element and quantity of solution double that found in any other open circuit cell.
Weigh carefully these advantages.

Its sale has steadily increased for ten years.
LAW TELEPHONE CO.,
Sole Makers,
87 JOHN STREET, NEW YORK.

WHAT WE CAN DO.

We can furnish you with Dynamos of the best System. We can also furnish you with Electric Construction of the finest quality, including supplies of all kinds. Our specialties: General Construction and Erection of Lighting Plants.

Address, W. L. POPPLE & CO.,
CONSULTING ELECTRICIANS
AND ELECTRICAL ENGINEERS,
407 The Rookery, CHICAGO.

PATENT PERFORATED
ELECTRIC LEATHER BELTING
MANUFACTURED BY
Charles A. Schieren & Co.,
45, 47, 49, 51 FERRY ST.,
COR. CLIFF ST.
BRANCHES:
BOSTON, 119 HIGH STREET.
PHILADELPHIA, 226 NORTH 3d STREET.
CHICAGO, 46 SOUTH CANAL STREET.

PROPOSALS FOR LIGHTS.

The undersigned will receive proposals for lighting the town of Henderson with seventeen 1,200 candle-power arc lights, or their equivalent, for a period of three or five years. Lights to burn every night. Proposals will be received until 12 o'clock M., December 28, 1891. The town reserves the right to reject any or all bids. Lights to be put in operation by the first of April, 1892.

By order of the Board.

J. H. BRIDGERS,
Clerk of the town of Henderson, N. C.
December 7, 1891.

LITTLE GIANT.
R. I. Telephone & Electric Co.,
Providence, R. I.

IF YOU have anything pertaining to electric machinery you want to sell, send us the description.
IF YOU want anything pertaining to electric machinery, send us your inquiries.
FRANK RIDLON & CO.,
Dealers in New and Second-Hand
Electric Light & Power Machinery,
196 SUMMER STREET, BOSTON.

DYNAMO and Motor repairing. Armatures wound for any system, at low prices. All work guaranteed. We furnish new Commutators. Agent for the "Billberg" Motor and Generator.

CORRESPONDENCE SOLICITED.

AUG. HUMMLER,
233 PENN AVE., SCRANTON, PA.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON DECEMBER 15, 1891.

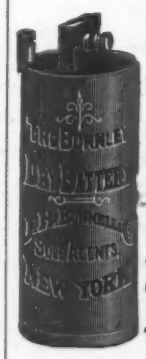
464,955 Means for propelling boats by electricity; Otto Büsser, Oderberg, near Berlin, Germany.
464,959 Telephone; Charles Cuttriss, New York, N. Y.
464,979 Electric signaling apparatus; George E. Miller, Lynn, Mass.
464,986 Electric conductor; William E. Oehrle, Philadelphia, Pa., assignor to Oehrle Brothers & Co., same place.
465,034 Electric car brake, Edmond Verstraete, St. Louis, Mo., assignor of one-half to Peter M. Kling, same place.
465,039 Portable electric lamp holder; John Baker and Henry S. Graham, Indianola, Iowa.
465,046 Automatic circuit breaker; William R. McLain, Des Moines, Iowa.
465,078 Means of controlling alternating current induction; Elihu Thomson, Lynn, Mass.
465,089 Riveting by electricity; Elias E. Ries, Baltimore, Md., assignor to Ries & Henderson, same place.
465,093 Electric belt; Andrew Erikson, Hawley, Minn.
465,104 Dynamo-electric machine; William P. Wiemann, Allegheny, Pa.
465,202 Coupling for electric conductors; Wm. C. Preston, Providence, R. I., assignor of one-half to Richard A. Bright, same place.
465,206 Packet or pad for electric batteries; Lewis H. Rogers, Brookline, Mass.
465,218 Adjustable rheostat; Frank J. Sprague and Charles R. Pratt, New York, N. Y.
465,233 Commutator connection for dynamo-electric machines. 465,234 Brush holder for dynamo-electric machines or motors; Carl O. C. Billberg, Philadelphia, Pa.
465,278 Electrical sewer gas indicator; James J. Lawler, Scranton, Pa.
465,292 Electric motor switch; Edwin W. Rice, Jr., Lynn, Mass., assignor to the Thomson-Houston Electric Co. of Connecticut.
465,349 Magnetic ore separator; Clinton M. Ball, Troy, N. Y.
465,359 Converter system for electric railways; Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.
465,360 465,361 Electric fan; Philip Diehl, Elizabeth, and Edwin H. Bennett, Jr., Bayonne, N. J.
465,365 Bracket for supporting electric conductors; John A. Duggan, Quincy, Mass.
465,369 Production of insulating coatings or linings in electrolytic apparatus; Ludwig Grabau, Hanover, Germany.
465,396 Train signaling apparatus; Paul Synnestuedt, Chicago, Ill.
465,404 Switch actuating mechanism for electric motors; Charles G. Armstrong, Chicago, Ill.
465,407 465,432 Electric railway; Geo. F. Green, Kalamazoo, Mich., assignor, by direct and mesne assignments, to Oliver S. Kelly, Springfield, O.
465,423 Electric heater; Warren H. Boles, Syracuse, assignor of one-half to George E. Waldron and John H. Reynolds, Troy, N. Y.
465,426 Electric switch and case for the same; Curtis P. Chappell, Providence, R. I., assignor to the Household Sewing Machine Co., Incorporated, same place.
465,430 Electric connector; William F. Z. Desaut, New York, N. Y.
465,442 Electrical indicating instrument; Edward Weston, Newark, N. J.

REISSUE.

11,210 Electric motor; Henry Groswith, Philadelphia, Pa., assignor, by direct and mesne assignments, to the Kennedy-Groswith Electric Co., same place.

JOHN A. BARRETT,
ELECTRICAL ENGINEER & EXPERT,
13 PARK ROW,
Room 28. NEW YORK.

Burnley Dry Battery
PATENTED JAN., 1890.



STRONGER than any Open Circuit Battery on the Market.
BETTER than any other Dry Battery yet produced.
Most compact in size and cheapest. 90 cents per cell.
Discount to the Trade and in quantities.

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